THE ELECTRICAL WORLD

A Weekly Review of Electricity

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CONTENTS.

ILLUSTRATED ARTICLES:	PAGE.
The Bassano-Slater Telephone	42
Gaiffe's New Medical Galvanometer	42
The "Brush" Factory at Cleveland	43
Lippmann Mercury Galvanometer	44
Electricity in Medicine	45
The "Eureka" Dynamo	47
The "Little Giant" Battery	48
EDITORIAL PARAGRAPHS	41
POETRY:	
Wire Commission Joys	48
MISCELLANEOUS:	
Tamidine	42
Reduction of Cable Earnings	42
Electric Lighting in Mines	43
Economy of Time in Electrotyping	43
Edison as a Pianist	44
The Underground Wire Commission	44
Primary Batteries for Electric Lighting	44
The Foreclosure Suit Against the Bankers and Merchants'	44
MISCELLANEOUS:	PAGE.
Condensation of Fumes	45
The Electric Tram-Car	46
Pacinotti vs. Gramme Armatures	47
Indiana Aroused	47
"THE ELECTRICAL WORLD" Bartholdi Pedestal Fund	48
The Electric Light in Newspaper Offices	48
The Electrical "Communicator"	48
CORRESPONDENCE:	
The Protection of Inventions by Patents	46
Wires and Magnets	47
Trouve's and Skrivanoff's Batteries	47
Batteries and Keys	47
DEPARTMENTS:	
New England Notes	48
Western Notes	49
The Telegraph	49
The Telephone	49
The Electric Light	49
Miscellaneous Notes	49
Applications of Power	49
Stock Quotations	49
Business Notices	49
Our Illustrated Record of Electrical Patents	50

New Advertisements.

Lytle & Co.—Electric Gauge iv
The Brush-Swan Electric Light Company of New England v
Rhode Island Telephone and Electric Co.—The "Little Giant" Battery v
Wanted—A Man for Dipping and Plating v
Wanted—An Electrician v
Jenney Electric Co.—Electric Lighting x

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ELECTRICAL exhibitions seem to be the order of the day, the announcement coming from Paris of a project for a new electrical exhibition to be held next spring. It will be under the auspices of the International Society of Electricians, and it is intended to make a special feature of electrical experiments and demonstrations. If the latter determination is adhered to we predict a great success, as nothing attracts the public more than an apt demonstration of an obscure principle.

IN another column we publish the circular issued last week and now being distributed throughout Indiana. The State law, which reduces the charge of telephone service to three dollars per month, has been evaded by the companies, who now charge an additional two dollars for the use of the wires and accessories. This we do not consider excessive. At any rate, the sooner the case is decided by the courts, the better for all concerned. It is for this reason that we hope the circular will bring out funds sufficient to defray the expenses of an early legal contest.

WE publish to-day an interesting and important contribution from Mr. H. B. Slater on "Economy of Time in Electrotyping." Judging from our own experience in getting matter electrotyped, we are forced to say that the time consumed in the process is far too great. There would probably be a considerable increase in the quantity of work given out if the time could be shortened. Now that Mr. Slater, who is an expert and one of the most thorough men in his line in this country, has given his views on the subject, we would very much like to see him afforded an opportunity to show what he can do practically. The problem is one of importance to all electricians, publishers and electrotypers.

THE widespread praise bestowed by the newspapers upon the telegraph companies and the press associations for the excellent work done in connection with the sickness and death of General Grant is justly deserved. When the General died at 8:08 A. M., the sad news was known from end to end of America and in Europe ten minutes afterward, and nimble fingers "pounding the key" and "sticking type," laid before the public early in the afternoon columns upon columns of descriptive matter. The vast amount of news handled has not yet been estimated, but it was enormous. It is an occasion like this that affords our operators a chance to demonstrate their true value, both to their employers and to the public, and employer and patron should not be slow to recognize the fact.

AMONG the incidents of the recent telegraph fight the graceful acknowledgment of defeat by the attorney of the Western Union Telegraph Co., Judge Dillon, deserves recording. Among the counsel for the Bankers & Merchants' Company was Mr. W. D. Guthrie, the junior member of the firm of Seward, Da Costa & Guthrie, who, as a boy, studied law under Judge Dillon. These two members of the bar were engaged on opposite sides in the fight, and when Judge Shipman ordered the Western Union to return the property of the Bankers & Merchants', Judge Dillon, counsel for the Western Union, came over to where Mr. Guthrie was receiving congratulations on the victory just achieved. Placing his hand on Guthrie's head the venerable lawyer said: "Will, I am proud of you my boy; you have not forgotten the law you studied under me." It was a case of pupil getting away with his master.

THE labors of the Underground Wire Commission may be said to have begun in earnest. At their last meeting they received several communications from persons having control of inventions for placing wires underground. One communication occupies a somewhat anomalous position, in that it relates to an aerial conduit, a subject which the commission may declare beyond its scope. Now that an actual consideration of plans has been undertaken, we believe that regrets will soon be heard that one member of the commission, at least, is not an electrician. Among the large number of devices that will necessarily come before it, we are free to say that the commission will not of its own knowledge be able to distinguish the wheat from the chaff. It may call in the assistance of competent men to help it out of its dilemma, but there is, we believe, no clause in the Daly bill which provides for the contingency, or any remuneration for services which might be so rendered. Thus, while the intentions of the commission may be of the best, its exclusively non-professional character must of necessity be a great bar to its usefulness and may lead to the adoption of methods which will work great injury to electrical interests.

MANAGER ULINE, of the Hudson River Telephone Company, has the reputation of being very successful in any work of construction he takes in hand. An amusing instance of his strategic skill and ability has just been reported from Rondout. Having obtained permission from the Common Council of Kingston to stretch wires from Rondout to that city, he put a gang of men on the work at once, but was soon notified that a virago with a revolver had stopped their operations. The person in question owns property in front of which are poles to which the wire was to be attached and as soon as the men began to climb the pole she presented the revolver at them and threatened to shoot. Manager Uline went at once to the scene and tried his powers of persuasion, but the woman remained obdurate. She thought she had triumphed, but was greatly surprised when Mr. Uline quietly obtained an injunction restraining her from interference. The wires have been strung. This instance is one that shows how unreasoning is the prejudice in some quarters, and how thoroughly it may be overcome by firm resolve and a use of the right measures. Mr. Uline was well within his rights, and can on no ground be accused of a want of politeness. A woman who threatens with a revolver men who are doing their duty, and under the permission of the authorities, might almost be said to have placed herself outside the pale of gallantry. Mrs. O'Reilly evidently maintains the old theory that within the limit of her estate she holds dominion "from the centre of the earth to the sky."

ONE of the most important, if not the most important, department of the Inventions Exhibition now being held in London is that devoted to electricity. The large number of excellent exhibits attracts crowds, and the electric illumination of the exhibition grounds is said to outrank in beauty anything that has thus far been attempted. But still all is far from being serene, as the electrical exhibitors complain bitterly of injustice, mismanagement and the officiousness of subordinates. It appears that besides the lack of ordinary conveniences, the most serious vexation is caused by the rule requiring the weekly renewal of passes of exhibitors and attendants. In order to remove these grievances an "Exhibitors' Association" is about to be formed for the purpose of taking united action in the matter. This is in marked contrast to the universal harmony which existed between the exhibitors and the management at the Philadelphia Electrical Exhibition last year. We have yet to hear of any well-founded complaint in this direction; indeed, the exhibition was so well managed that it appeared to run itself—an excellent sign of good supervision. We hope, however, that our electrical brethren over the sea will soon have their grievances set aright, so that they will not be compelled to remove their exhibits, as they have rashly threatened to do.

THE twenty-eighth of July marked the completion of nineteen years since telegraphic communication was permanently established between the New World and the Old, during which time the almost instantaneous communication has never been broken, one or other of the cables being always in working order. Thus the experience of a fifth of a century shows that Lord Byron was not contemplating a submarine cable when he wrote that man's control "stops with the shore," for our daily greetings pass unhampered through the dark unfathomed caves of ocean as quickly and easily as they do over the cis-Atlantic hill and dale. But the mention of the anniversary calls to mind a curious error. The cable dispatches on Monday last, the 27th ult., said "to-day" is the nineteenth anniversary, etc. On this side of the ocean we have always considered Tuesday, the 28th of August, as the day when the 1866 cable was completed, and the difference in time at or near midnight could not in any way account for the discrepancy in the dates. But when we recollect that it is only three weeks since our trans-Atlantic friends told us, by cable, that they were preparing for a grand jollification on the occasion of the fiftieth anniversary of Queen Victoria's accession to the throne *next year*, and we know that that important event occurred in 1837, we can rest secure in the thought that the cable is not infallible.

IT is once more reported that the bitter rivalry between the Baltimore & Ohio and Western Union is to end in the absorption of the former by the Western Union. Statements are made with great positiveness by Mr. Gould's friends that the practical control of the lines has been offered to the Western Union. Such statements are denied with equal positiveness by the managers of the Baltimore & Ohio Telegraph Company. It is said that Mr. Gould is to furnish the Baltimore & Ohio Railroad with terminal facilities at New York, which that company stands very much in need of just now, on account of the recent alliance between the Pennsylvania and New York Central to shut the Baltimore and Ohio Railroad out of this city, and that all he asks in return is that he be given the control of the Baltimore and Ohio telegraph lines. It is reported that Messrs. Garrett, Field and Pender had a conference recently in London, and this is thought to lend probability to the rumor. A friend of Mr. Gould said, a day or two ago: "It is a fact that the Baltimore & Ohio telegraph lines have been offered to Mr. Gould. I know that this statement will be denied by some of the Baltimore & Ohio people, but it is a fact nevertheless. It may be that nothing will be accomplished in this matter for some time, but I think that by Jan. 1, 1886, you will see but one telegraph company in this country."

TELEPHONE litigation in England seems in a fair way of approaching in magnitude the extended suits which have been carried on in this country. At present the owners of the Edison transmitter patent are seeking damages from the proprietors of the Bassano-Slater telephone, for an alleged infringement of that portion of the patent which relates to the transmitting instrument. Scientific evidence is offered in great abundance, the experts testifying being such eminent men as Sir William Thomson, Dr. John Hopkinson, Sir Frederick Bramwell and others. A large portion of the testimony taken was for the purpose of clearly defining the word "diaphragm," since the defendants claimed that they used no such device in their instrument. From the description, the latter seems to be an ordinary microphone transmitter, with loose carbon contacts, but without any diaphragm, as used by Edison and as that word is taken in the ordinary sense. It seems, however, that the word has a telephonic meaning, and so Sir William Thomson testified. In his opinion it would be perfectly correct to call a sounding board a diaphragm in the sense in which Edison uses that word. He bases this opinion upon experiments which he made, and which went to show that the addition of a board at the back of a stick holding the carbons converted inaudible sounds into articulate speech, as might have been expected. The case is still undecided, and its conclusion is looked forward to by a large number of patentees besides the ones directly interested.

Tamidine.

Those who had the good fortune to attend the Philadelphia Electrical Exhibition had an excellent opportunity of inspecting a number of important processes in the manufacture of incandescent lamps. At what might be called Mr. Weston's exhibit, the treatment of the carbonized filaments attracted spectators, both professional and non-professional, and specimens of the uncarbonized threads and the material from which they were produced were freely distributed. This material, which Mr. Weston has called "tamidine," is a form of cellulose, and the history of its adoption and mode of manufacture will no doubt prove interesting to our readers.

The object sought after was the production of a material which should have the greatest possible homogeneity, a quality which cellulose in the ordinary state, as met with in nature in the form of woody or vegetable fibre, does not possess. Various attempts have been made to modify the fibrous structure of the base from which carbons are prepared, and it will be remembered that some years ago Mr. Swan devised the process of parchmentizing thread and paper before carbonizing, and the results obtained were an improvement on the old method.

Following out another idea, Mr. Weston, some years ago, began a series of experiments on the production of a homogeneous base, for obtaining homogeneous carbons. He naturally sought, in the first place, to dissolve cellulose, and used several well-known solvents of this body, among them cupra-ammonium compounds. Although he attained a fair measure of success in this direction, he found it impossible to obtain such results as he desired.

He now devoted himself to a new line of investigation. It is a well-known fact that all the forms of cellulose, such as cotton, linen, etc., if subjected to the action of mixed nitric and sulphuric acids, become converted into a substance which, while not apparently differing in structure from the original, possesses new and important chemical properties. This substance is known generally as pyroxyline, or gun-cotton, or nitro-cellulose. It is almost perfectly soluble in various menstrua, such as mixtures of ether and alcohol, nitro-benzole and naphtha, acetic acid, and many of the essential oils in combination with other bodies. Chemists and photographers in particular know what beautiful, tough and transparent films of homogenous pyroxyline collodion will leave on glass, and how easily it may be removed from the latter. This homogeneous pyroxyline possesses all the physical properties of the substance Mr. Weston was seeking for, but it cannot be carbonized, since at a comparatively low temperature it decomposes and leaves practically no solid residue. It is obvious that in this condition it is of no value whatever as a base from which to obtain carbons.

In the more complete works on chemistry it is stated that gun-cotton can be reduced to ordinary cotton again by the action of certain reducing agents, such as ammonium sulphide, ferrous chloride, etc. This change is practically brought about by abstraction of the radical nitryl (NO_2), and is substantially a reversal of the chemical changes which take place when gun-cotton is produced from cotton by the action of sulphuric and nitric acids. Seizing on these facts, Mr. Weston began to experiment on the reduction of collodion films, and discovered that under proper conditions, films and even quite thick sheets of homogenous pyroxyline could be completely reduced by the action of ammonium sulphide, and in this way perfectly transparent, homogenous and extremely dense cellulose could be obtained. By perseverance he has succeeded in overcoming all the practical difficulties connected with the process, and has made this principle subserve a practical commercial use probably for the first time since it had a place in chemical knowledge and literature.

The process is now carried on in his laboratory in the following manner: Paper is treated with a mixture of nitric and sulphuric acids so as to form an exceedingly soluble pyroxyline capable of yielding an extremely tough, dense film when the solution is poured on glass. This pyroxyline is dissolved in any of the well-known solvents, the solution poured into deep trays and the solvents allowed to evaporate very gradually. After the evaporation has proceeded to a certain extent, and the mass is capable of being handled without injury, the cakes or blocks are removed and placed in strong wooden frames, to which the edges of the blocks are firmly clamped. After some time the solvents entirely evaporate and a sheet of solid pyroxyline about ¼ in. thick, 10 in. wide, and 16 in or 18 in. long, is obtained. These thick sheets are placed in a machine and cut up into sheets about .006 inch thick. They are next immersed in a bath of ammonium sulphide for about one hour, then thoroughly washed, dried, and rolled to the desired thickness necessary to form the carbon filaments. These sheets of "tamidine" are now transparent, flexible, of great strength, and found to have recovered the properties of cellulose, burning in air much like paper, and leaving a crisp, dense carbon residue; and when baked in muffles at a very high temperature it yields a carbon very hard, of great flexibility and high specific resistance and perfectly homogenous.

Of course the process is capable of various modifications, as the nitro-cellulose can be readily formed into a plastic mass and forced through a die in the form of threads, the plan which is followed in the manufacture of homogeneous pyroxyline (know as celluloid). The threads will then be reduced in precisely the same way as the sheets, cut up into proper lengths and baked as above described, to form the carbon filaments.

The Bassano-Slater Telephone.

This telephone, recently invented, makes use of a novel device for causing the vibration of a tympan, and our contemporary, the London *Electrical Review*, pronounces the instrument to be loud and distinct in its enunciation. In the accompanying illustrations, Fig. 1 is a section of the complete receiver; Fig. 2 a plan of an improved arrangement of bar armature; and Fig. 3 a section of a steel wire T-piece, carrying a disc of pine or other non-inductive material. Corresponding parts are indicated by the same letters. In Fig. 2, *a* is a brass rim having an outer ridge or collar *x*, and four small ears or lugs *b b b b*. *C C*¹ are two soft iron bar armatures fixed on centre screws *d d d d*. These two bar armatures are kept in a state of tension by means of a small piece of thin steel wire *e*, passing through a hole in the centre of the two armatures and riveted, or otherwise secured, only just at the ends of the wire, so that the greater part of the wire, even where passing through the armatures, is free to twist or untwist. To the centre of this small piece of wire is brazed a steel or iron pin *i*, with a screw thread forming together a T-piece, shown in section, Fig. 3. The pin *i* carries a small brass washer *h*, upon which rests a circular

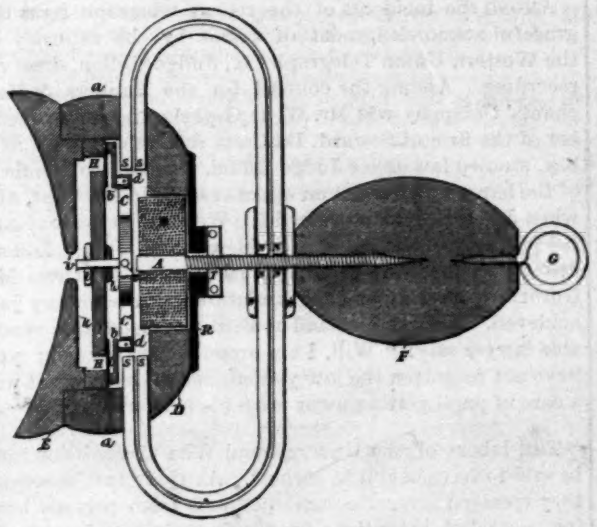


FIG. 1.—BASSANO-SLATER TELEPHONE.

disc *k*, of pine or other non-inductive material, to the outer edge of which is glued a circular rim *l*, of thin leather, mackintosh, or other air-tight material, the disc being held at its centre by a small brass nut *t*. Taking the arrangement of Fig. 2, if a magnet is caused to ap-

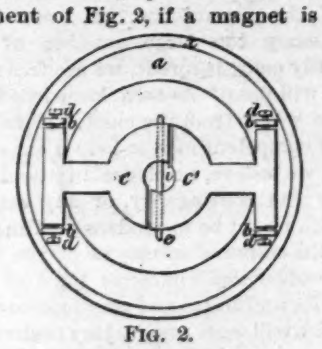


FIG. 2.

FIG. 3.

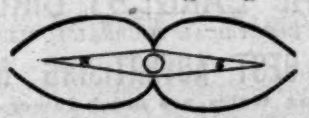
proach the centre of the bar armatures *C C*¹, they are pulled out of their normal position, and, being centred at opposite points, and each firmly gripping the small piece of steel wire *e*, which is squared just at its two ends, give the wire a slight twist in opposite directions. If the magnet is now withdrawn, the wire untwists, and throws the armatures sharply back into their normal position. Since the wire *e* carries the pin *i*, and the disc of pine by its centre *k*, it follows that the latter, every time the armatures move, will also make a bodily movement backward or forward, according as the bar armatures are attracted or released by the magnet. When, therefore, it is inclosed in a recess or air chamber, as in Fig. 1, a condensation and rarefaction of the air takes place in the recess formed by the cap *E*, corresponding to the condensations and rarefactions of the air operating the electric current at the transmitter, and which alter or reverse the magnetism in the magnet of the receiver. It is obvious that the effect all depends upon the torsion of the small piece of wire *e*, of thin, hardened steel, the pitch and loudness of the sound depending upon the velocity and amplitude of the vibration of the disc *k*. The inventors have therefore taken four U-shaped steel magnets, and placing their four similar or north poles, *N N N N*, between the two soft iron rings *W W'* (tapped to fit the thread on *A*), to polarize the soft iron screw *A*; and the four south poles, *S S S S*, to magnetize the two bar armatures *C C*¹ by magnetic induction, it is clear that a most intense magnetic field will be set up just at the end of the pole piece *A*, and which causes the movement of the armatures to be extremely sharp when the magnetic field is altered by the electric current. The object of the thin ring of leather *l* (which is fixed loosely, so as not to impede the movement of the disc *k*) is to make the movements of the pine disc air-tight. It is not, however, essential, but improves the efficiency of the instrument. A brass ring *H* clamps the thin leather, and it is in its turn secured by the screwed cap *E*.

Gaiffe's New Medical Galvanometer.

In this apparatus, which contains but one needle, and has no directing magnet correct proportion between the intensities and deflections is obtained by means of a special form given the frame upon which the wire is wound.

We give herewith, from *La Lumière Electrique*, a figure of the curve that Mr. Gaiffe has fixed upon after numerous experiments. Upon examination it will be seen that the needle approaches the current in measure as the directing action of the earth increases; and experiment proves that the two actions counterbalance each other, and render the deflections very nearly proportional to the intensities, up to an angle of from 65 to 75 degrees.

Another important fact has likewise been ascertained, and that is that, under such circumstances, the magnetic intensity of the needle may change without the indications ceasing to have the same exactness up to 65 degrees. As well known, Mr. Desains has demonstrated that this occurs likewise in sine or tangent galvanometers; but



GAIFFE'S MEDICAL GALVANOMETER.

these have helices that are very large in proportion to the needle. In medical galvanometers the proportions are no longer the same, and the needle is always very near the directing helix. If this latter is square, or even elliptical, it is found that, beyond an angle of 15 degrees, there are differences of 4 or 5 degrees in the indications given with the same intensity of current by the same needle, according to the latter's intensity of magnetism. This inconvenience is quite grave, for it often happens that a needle changes its magnetic intensity, either under the influence of too strong currents sent into the apparatus, or of other magnets in its vicinity, or as a consequence of the bad quality of the steel, etc. It was therefore urgently required that this should be remedied, and from this point of view the new mode of winding the wire is an important improvement introduced into medical galvanometers.

Reduction of Cable Earnings.

The remarks of Chairman John Pender to the stockholders of the Direct Cable Company at their half-yearly meeting in London has created a great deal of comment in commercial and Wall street circles. His statement that "During the six months our traffic and returns have steadily declined" was a very mild admission of the blow that has been given to the old cable monopoly pool by the competition of the Commercial company's service. When the latter opened its two cables to the public on Christmas Eve last, it fixed its rates twenty per cent below those charged by the Gould monopoly cables. As the latter were forced to meet this reduction, it was noted at the time that the laying of the new cables would save the public from the start one-fifth of the $5,000,000 per year it had been paying for cable service, the gross receipts from the public being thus reduced by $1,000,000 to begin with, and with the unprecedented service of the new cables, competing for their share of the smaller sum, it is not strange that the pooled companies are in a bad way. The fate of the cable pool is another illustration of the fact that no such combination to tax the public upon watered capital can succeed in the long run.

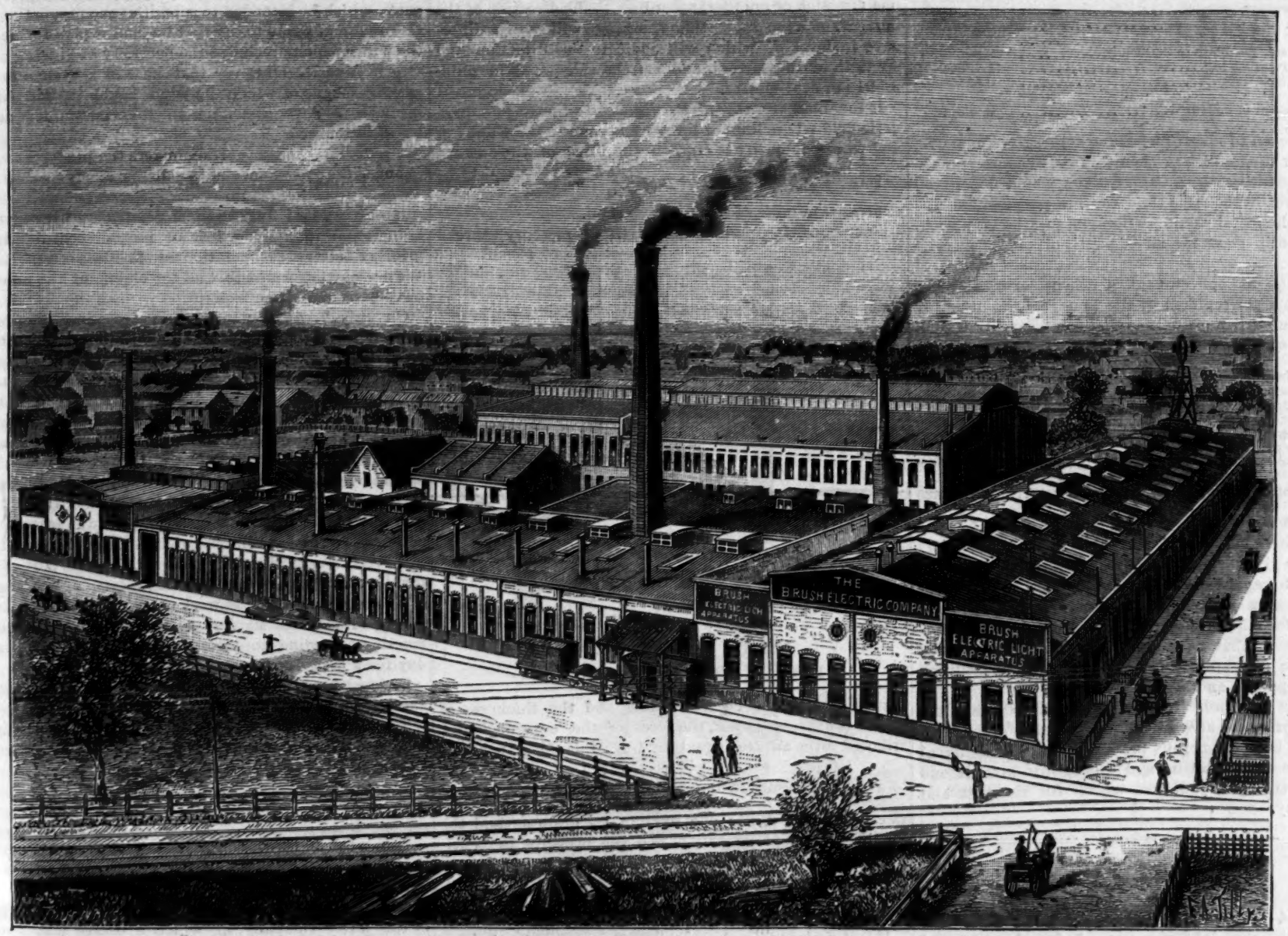
From the data furnished by the Direct company's report for the six months it is possible to estimate the condition of the other companies, since each has received a fixed percentage from the pool. When Mr. Gould, after capturing the telegraph companies here, got possession of their traffic contracts with all the cable companies, forced a pooling of the four companies with their eight cables, the amount allotted to the Direct company was 16.27 per cent., or a trifle over one-sixth of the whole. The receipts of the Direct company for the half-year just ended show a decrease of $160,000 as compared with the returns for 1884. This would make the decrease of the Direct company for the whole year $320,000, and the total decrease of the pool being six times that amount, would be $1,920,000 for the year. The share of the two distinctively Gould cables (American Telegraph and Cable company's) in the pool is 22½ per cent. and their earnings for the year would consequently show a decrease of $431,000 as compared with 1884. This would give them about $569,000 for the current year, and deducting $150,000 for operating expenses, leaves their net earnings about $400,000. After building these cables Mr. Gould capitalized them at $14,000,000 (more than double their cost) and caused the Western Union to lease them, guaranteeing five per cent. on that amount, or $700,000 per year. As it appears from the foregoing calculation that the Western Union will receive on the cables this year only $400,000, it will have a deficit of $300,000 on account of the Gould cables.

The "Brush" Factory at Cleveland.

Among the many large industries represented in Cleveland, Ohio, that of electric lighting occupies a prominent position. It is here that the works of the Brush Electric Company are situated, and where all the apparatus composing their system is manufactured.

Our illustration gives a good idea of the size and extent of the buildings required to carry on this work. The outside dimensions of the buildings are 700 by 275 feet and they are divided into different apartments as follows: Main machine shop, two engine rooms, two boiler rooms, carbon department, foundries, smithy, carpenter shops, tin shops, finishing shops, winding rooms, storage department, storage power building, and testing rooms. Most of these departments are again subdivided into smaller departments. The superintendent's office is in an elevated position in the centre of the main machine shop, a point from which he can survey all of the operatives in this the largest department of the works. These various departments contain a large amount of machinery and tools of all descriptions, many of which were built from special designs.

The engines and boilers which furnish motive power are capable of working up to 800 horse-power, and the number of men employed varies from 400 to 600, according to the season of the year.



THE "BRUSH" FACTORY AT CLEVELAND.

With these large resources the factory has a capacity of 1,500 lamps per month, together with the corresponding machines. The number of furnaces in which the carbons are baked is 45; 36 of these being small and 9 of large size, and they have a total capacity of one and one half million of carbons of all sizes.

We may add that the number of Brush arc lamps sold and in use to-day is 30,000, and among the principal cities in this country lighted on the Brush system are the following:

NUMBER OF LIGHTS (BRUSH)—CENTRAL STATIONS.

New York	1,800	Indianapolis	300
Philadelphia	1,000	Minneapolis	350
Albany	525	Pittsburgh	320
Boston	600	Rochester	550
Baltimore	650	St. Louis	300
Buffalo	650	Salt Lake City	150
Cleveland	400	Cheyenne	150
Denver	400	New Orleans	800
San Francisco	500	Galveston	150
Sacramento	150	Toledo	200
Los Angeles	250	East Saginaw	200
Norfolk, Va	200	Bay City	200
Cincinnati	400	Troy	250
Detroit	600	Savannah	150
Evansville	175	Trenton	150

And about 100 other companies running 150 lights and less.

From the above it is evident that great enterprise has been shown in the management of the Brush company, which was one of the first in the field,

Electric Lighting in Mines.

The *Annales des Ponts et Chaussées* for May, 1885, describes the introduction of the electric light into the lead mines of Mechernich, Eifel.

These mines are worked partly in open cutting and in part by subterranean galleries. A beginning was made by lighting an immense quarry, which is no less than 2,170 feet long by 1,133 feet wide and 347 feet deep. Apparatus put directly into the quarry was promptly destroyed by the shock resulting from blasting; the expedient was then adopted of placing the lamps at the level of the natural ground and projecting the rays by powerful reflectors upon the work. Two Siemens plants, of 3,000 candle-power each, have been located under these conditions, and are found to give ample light.

The record kept by the administration of the mines demonstrates that the electric light is cheaper than the feeble light from mineral oil, which it replaced. The entire apparatus, with reserve machinery, mounting, etc., cost only 13,750 francs. The expense of running it, including interest on cost and depreciation of plant at 15 per cent., amounts to 2.30 francs per hour, while 89 lamps fed by petroleum and 15 oil lanterns exceeded 3 francs in cost for the same time.

As soon as it was found that electric lighting met all the requirements in this portion of the mine, experiments were made in the subterranean portions, where the galleries are about 328 feet long, 98 feet wide and 49 feet high.

In former times the workmen, after each explosion, examined the roof for loose rock and the effect of the blast generally by the feeble light of torches. After several experiments it was proven that a Siemens lamp of 350 candle-power gave the desired results, and these were then adopted in all the galleries.

The plant for this portion of the mine includes ten lamps of 350 candle-power each. The electric machinery which runs them is placed outside of the excavation, and the electric current is conducted to the lamps by wires encased in lead where they run down the shafts to the galleries. The conductors are formed of bundles of wires insulated by gutta percha, and they are sufficiently flexible to permit them to be detached from the lamps during blasting. The total length of the circuit is about 9,840 feet.

Economy of Time in Electrotyping.

BY H. B. SLATER.

The value of time in the processes of electro-deposition of metals, especially in that branch of the art known as electrotyping, is a matter of such important consideration that any improvement in this direction must be of great advantage, both to the electroplater and the electrotyper, but especially to the latter.

In depositing a coating of metal, as gold, silver, nickel, etc., upon an article of baser metal, to preserve or enhance its beauty, it is seldom considered necessary to take into account a little extra time so long as a good reguline deposit is obtained; but, on the other hand, in electrotyping time is often of the greatest importance. The publishers of a magazine, or other periodical publication, have their regular time for going to press, and, usually, barely sufficient time is allowed for printing and binding before the hour for issue, owing to the desire to present the very latest news to subscribers. It will easily be seen, then, that in the case of such parts of the work as are electrotyped, the electrotyper should be so able to control his solutions and his current that not a moment will be lost in doing useless work. He should be able to get every possible atom of metal upon his mold in a given time consistent with required conditions as to quality of metal, etc.

There appeared recently in the English papers an article on "Dynamo Electrotyping" at the English Ordnance Survey Office, by Captain H. R. Sankey, R. E., in which it is admitted by the writer that prior to January, 1884, the work at the survey office had been done by the "rule of thumb" system, although some experiments had been made with a view to getting out of the old ruts. For the success attained in the experiments, as given in the paper read by him and above referred to, Captain Sankey is entitled to great credit, and especially for the clear display of the details and results. His aim, however, as he says, was to obtain "copper of a certain quality and not to deposit it in large quantities."

Where an electrotype has to bear engraving, as is sometimes the case with certain kinds of work, it is necessary that the deposit should be of a quality suited to that purpose, but in general practice a good, smooth shell is all that is needed, and such can be laid on in much less time than a sheet of the same thickness, but of a quality suited to engraving.

The quality of metal deposited from a given solution is dependent upon the condition of the solution and the density of the current. It appears from the results of Captain Sankey's experiments that the density of the current for his purpose is limited to about seven or eight ampères per square foot of surface. He says nothing of the condition of solution, however, but we suppose that it was at its best for the purpose. For the general electrotyper a density of eight ampères per square foot would be slow work indeed, as it represents only about one-half pound of copper deposited in twenty-four hours, or about one grain per square inch per hour; yet, judging from the time consumed by electrotypers in depositing a shell for an ordinary *cut*, it would seem that they are little better off as regards time, while not so wel

off as regards the quality of the metal. But, as said before, the same quality of metal is not required.

There is no doubt that much time can be saved in the process of depositing copper, as practiced by electrotypers generally. There is no more reason why it should take from 3 to 5 hours to deposit a shell of copper of the thickness and quality generally laid on, than there is that we should go back to the galvanic battery for our source of electricity.

Electrotypes for general printing purposes have a shell of copper, which will run, on an average, at 3 grains per square inch. With a current suited to Capt. Sankey's purposes, it would require at least three hours to deposit such a shell.

In experiments made some time ago, shells of good, tenacious copper were obtained with a current of 28 ampères per square foot, which gives about 35 grains per square inch per hour. Accordingly, a good shell can be deposited in one hour or less.

Sprague, in his "Electricity: its Theory, Sources and Applications," states that 24 ampères gave a very good deposit of tough metal, which tore without cracking. A current whose density is 24 ampères per square foot will deposit 3 grains per square inch per hour.

A problem in which is required the number of pounds of copper which can be deposited on 3½ square feet in 24 hours by a current of 24 ampères, he works out as follows:

Ampère grain unit = .000158 log	— 4.1986571
Copper equivalent, log	1.5017437
Grains to lb. = 1 ÷ 7000 log	— 4.1549020
Ampères per foot = 24 log	1.13802112
Time { Seconds per hour = 3600 log	3.5563025
Time { Hours = 24 log	1.13802112
Area in feet = 3.5 log	0.5540680
Copper deposited = 5.32 lbs	0.7260957

This, reduced to square inches and hours, gives, as above, 3 grains per square inch per hour. This, of course, far exceeds the quantity which Capt. Sankey would deposit on the same area in the same time for his purpose, but the quality of the metal would, as Sprague says, be very good, and sufficiently good for all general purposes of electrotyping.

If we take as our current a density of 28 ampères and work out the problem by the same rule as used by Sprague, we shall have, with other conditions, the same, 6.2 pounds of copper instead of 5.32 pounds.

Ampère grain unit = .000158 log	—4.1986571
Copper equivalent, log	1.5017437
Grains to pound = 1 ÷ 7000 log	—4.1549020
Ampères per foot = 28 log	1.4471580
Time { Seconds per hour = 3600 log	3.5563025
Time { Hours = 24 log	1.3802112
Area in feet = 3.5 foot	0.5540680
Copper deposited = 6.2 pounds	0.7930425

This, reduced to square inches and hours, gives 3.5 grains per square inch per hour, as stated above.

There is a given condition of the electrolyte which is best suited to rapid work, and this can best be found for each solution by experiment. It would be impossible to give a rule for all, as different operators work with different solutions. That is, various proportions of acid and the metallic salt are used, and a rule for one solution would not apply to another.

The "rule of thumb" system is all that stands in the way of a more rapid and satisfactory method of electrotyping than is now generally practiced, and the intelligent operator can save both time and money for himself and his employers by a judicious search for the best and quickest way.

Edison as a Pianist.

Thomas A. Edison, the inventor, although somewhat deaf, is passionately fond of music. A friend of his describes how he passed the time when he took relaxation from his studies. "He has a piano in his elegant home that is pounded on most vigorously by the famous electrician two or three times a day. He does not play by note, but has a wonderful quick ear to catch popular and even difficult opera airs. His deafness is not so great as to interfere with his hearing music. It is amusing to see him getting a tune out of his ivory keys. He looks very much as if he were at a telegraph key sending off a quick dispatch, and wanted to rattle the operator at the other end by his lightning rapidity. Sometimes he will play a piece with his forefinger only. It moves like a phantom finger, so hurriedly does it pass over the keys. He goes to the opera frequently and immediately upon returning home, no matter how late the hour, he sits at the piano and rattles off some of the catchy airs. It is a very poor opera that Mr. Edison does not play some part of. Opera bouffe is his favorite syle of music. All at once he will strike up "Semiramide," and wind up with something from "The Little Duke" or "Falka." His playing is not bad. He has a nervous, quick touch which, if combined with a ready knowledge of notes, would make him a great performer. He plays more to amuse himself than anything else, and to relieve his mind of the strain he puts upon it by constant study. When questioned about his musical qualities, he laughs and says he does it to rest. It may be possible that he intends to invent an electric piano, or simplify the present mode of construction."

Lippmann Mercury Galvanometer.

The accurate measurement of the strength of electric currents is a subject of considerable importance, and much ingenuity has been expended in devising apparatus for the purpose. Indeed, there is hardly a phenomenon based upon the action of electric currents which cannot be applied as a basis for such an instrument, but success must necessarily be limited to the accuracy with which such instruments are able to operate. Recently M. Lippmann has devised an ingenious galvanometer, with which very accurate results are said to be obtained.

This "mercury galvanometer," as it is called, depends upon the principle that if a conductor be placed in a magnetic field perpendicular to the lines of force, a current, c, passing through it will have the tendency to move it parallel to itself and at right angles to the lines of force; and the moving force is equal to the current c, multiplied by the intensity of the magnetic field H.

Thus, if, as in Fig. 1, a thread of mercury in a fine tube be placed between the poles of two powerful magnets, then upon passing the current to be measured through the mercury, the latter will move or rise in the tube proportionally to the strength of the current.

If the mercury thread be connected to the two branches of a pressure gauge, as in Fig. 2, the neutral or low point of the gauge being formed by the thread, then a current passing through the latter will cause a motion in one direction or another, according to the direction of the current. At the same time the gauge will show a difference in level d, which will indicate the direction and strength of the current, and can be calculated in millimetres or centimetres.

If the mercury thread B, Fig. 2, be situated in a magnetic field whose lines of force are normal to the plane $l\,d$, and whose intensity is H, then the force of the current expressed in degrees will be $p = \frac{H\,c\,l}{10}$, when H and c are expressed in units of the c. g. s. system.

But since l equals the length of mercury thread

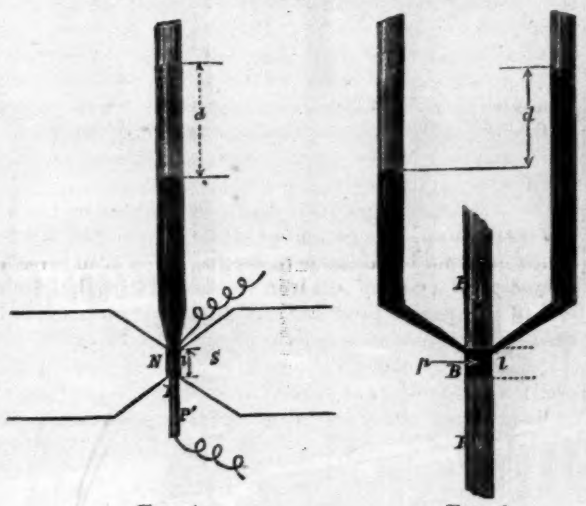


FIG. 1. FIG. 2.

LIPPMANN MERCURY GALVANOMETER.

through which the current flows, and the thickness of which is expressed by E, the force of the current is distributed over an area equal to $l\,E$; therefore, per unit of area the pressure in dynes is $p = \frac{H\,c}{10\,E}$ E being expressed in centimetres. Since one dyne = $\frac{1}{981}$ gramme and the specific gravity of mercury is 13.6, the pressure in centimetres of mercury may be expressed thus:

$$d = \frac{H\,c}{10 \times 981 \times 13.6\,E} = \frac{H\,c}{133416\,E}$$

If it is desired to make d, the difference in level, very large—in other words, to make the instrument very sensitive—it becomes necessary to make H very large and E very small, so that for a sensitive instrument a capillary tube would have to be used and placed in an intense magnetic field. The intensity, H, can be made very great by bringing the poles close together, and this condition can be easily fulfilled in connection with the capillary tube.

The firm of Breguet make the tube of a diameter of 0.01 centimetre, and the area of the contracted magnet poles between which the mercury tube is placed equals 19 sq. millimetres.

The maximum degree of sensitiveness which has been attained thus far is a difference in level of 14 centimetres per ampère or unit of current. The intensity of the magnetic field in which these measurements were made was 18,678 absolute units, or 96,776 times greater than the normal magnetic intensity of the earth at Paris (0.193 units).

The Underground Wire Commission.

This commission met again this week at the Metropolitan Hotel, in this city, with President Loew in the chair. Secretary Theodore Moss announced that he had notified 22 companies and individuals controlling telegraphic or telephonic wires of the resolutions passed by the commission at its first meeting, and had taken a receipt for his communication in each case. Since then he had discovered 70 other corporations and individuals, owning or controling wires, and these would be notified as speedily as possible. Mr. Moss expressed his surprise at the number of persons interested in the wires which disfigure the city, and thought he had not yet reached the end of the list.

During the meeting, Commissioner Hess, with an innocent smile, asked if any of the companies had notified the Secretary of new wires which they intended to stretch, as requested by the resolution offered by him last week. He was told that nothing had been heard from any of the companies in regard to the matter. Mr. Hess did not express any surprise, but he looked grieved when Mr. Moss announced the manner in which his request had been treated by the corporations.

A number of communications were read from persons having plans to suggest for burying the wires, and the Secretary was instructed to notify the writers that they would be considered after Aug. 13, which is the last day under the law given by the different companies to propose plans. Among the communications was one signed by Stephen M. Chester, of No. 26 Church street, urging that the companies should not be allowed to lay their own wires, but that a separate corporation for this purpose should be formed, with a franchise permitting it to lease its wires to the companies. Mr. Chester frankly admitted that he did not propose to assume the rôle of a disinterested party in making his suggestion, but that he had a plan of his own for organizing an underground wire company, which he intended to submit at the proper time. E. C. Townsend wrote to say that he had a plan for burying the wires which precluded the necessity of digging up the streets, and M. H. Devey that he had a system to suggest, by means of which the wires could be laid without insulation. After listening to the communication the board adjourned.

Primary Batteries for Electric Lighting.

In our issue of July 18 some particulars were given relating to an interesting test of incandescent lighting by primary battery, in operation at 51 State street, Boston. We are now informed that all the claims of the inventors have been more than realized.

On July 7, at 12 M., a battery of nine (9) cells was started at lighting two 8 candle-power lamps, six minutes on and six minutes off, day and night, the interruptions being accomplished by the aid of an ordinary 24-hour clock. This was continued until July 20, at 10 o'clock A. M., when the lamps had been burning a total of 152 hours. The object of this arrangement was to get the 152 hours inside of 12 days, while in practice they would be spread over six weeks. It was found on July 20 that the battery was by no means exhausted, so without any renewal of the depolarising liquid it was started on a consecutive run. At the end of the 152 hours ½ lb. of zinc had been consumed in each cell, making the cost of zinc for the nine cells 45 cents. The inventors, Messrs. Kauffer & Goldner, state that the work put upon the battery in the test described was harder than it would have been if running according to their original claim, four hours a day for a period of 38 days.

The test has been watched with much interest, and was carried out by parties other than the inventors themselves.

These tests show some remarkable properties in the batteries used and may lead to important developments.

The Foreclosure Suit Against the Bankers & Merchants'.

Last week Judge Donohue, in Supreme Court Chambers, denied the motions to set aside the decree of foreclosure in the suit of the Farmers' Loan and Trust Company for the forclosure of the $10,000,000 mortgage upon the property of the latter company, in which a decree was entered authorizing the sale of the property, and for the removal of the Trust Company from its position as trustee of the mortgage. The decree in the foreclosure suit was entered upon consent of all parties to it. Judge Donohue says that there are many defects in the decree, and the specific property sought to be covered by it, he says, can nowhere be found in the decree. Therefore, when the referee comes to sell the property, it will be somewhat difficult to tell what he sells and where he gets the power to sell any definite property. But the Court agrees with the Trust Company that the applicant, who represents $250,000 of bonds, has no right at this time to intervene as a party to the suit, and for that reason the motion must be denied. He disagrees, however, upon the point that the objections are matters addressing themselves to the purchaser. He says:

"In my judgment this goes to the title of the property, and all dealings with it take with it full notice of the defects, and it seems to me buy with it, as one of the counsel for the bondholders remarked, 'a crop of lawsuits:' but on this application of the moving party I cannot interfere. On the motion for removal, I do not consider the merits at all, as a large mass of the bondholders now appearing are satisfied with the trustee. The Court fully agrees with the plaintiff on the propriety of an early sale, and pointed out the necessity long since of such a course, but I do not agree with them on either the necessity or propriety of what may be selling what may prove a defective title."

Electricity in Medicine.

As the value and efficacy of electricity as a remedial agent is becoming more and more recognized, some authentic information and the latest knowledge regarding its properties and effects when so applied, will no doubt prove of interest to our readers. We give, therefore, today the salient points of the first of a series of lectures by Dr. Ambrose L. Ranney, of New York, delivered before the Medical Department of the University of Vermont, Burlington.

Dr. Ranney, in speaking before students having little or no knowledge of applied electricity, enters into details with which our readers are acquainted and we therefore omit such parts.

In the diagnosis and treatment of nervous diseases no agent is more generally applicable than electricity. Its brilliant and often instantaneous effects and the prevalent belief among the laity that electricity is practically identical with the vital forces of the human body have conduced largely to the general use and *frequent abuse* of this important agent.

Thousands of electric batteries are sold yearly by the various manufacturers to persons both in and out of the medical profession. Many who buy them are utterly ignorant of the principles of their construction, and equally so of the indications for their use. A very large majority of the medical profession possess only a faradaic battery or a magneto-electric machine. They employ such a battery upon every case which to their mind requires electricity. A few, in our larger cities, own a galvanic battery; but, as a rule, those who do so are unable to repair it themselves when the connections become oxidized or when it fails to act from a multitude of other causes. In my experience it is very uncommon to meet a medical practitioner (outside of those who are specially interested in neurology) who thoroughly understands electro-physics and many important facts relating to the uses for which special forms of batteries are best adapted.

The uses of electricity in diagnosis, as well as its therapeutical properties, will be also presented in as concise a form as is comportable with clearness of statement.

Under the heading Electro-physics we shall first discuss the varieties of electric currents which may be produced (the faradaic, galvanic, magneto-electric and static).

A few of the more important facts relating to this agent (which we are constantly called upon to employ in the treatment of various types of disease) should be thoroughly understood by all who intend to use it. Time will not permit of a detailed description of the different properties of electric currents. These can be acquired from any of the standard works upon physics. It is necessary, moreover, that the points presented here should be briefly and simply stated.

The galvanic current (called also "*voltaism*," the "*battery current*," and the "*constant current*") is one which is derived by chemical decomposition or heat from one or more pairs of elements directly. When the body is placed between two electrodes connected with such a battery in action, the current traverses the part of the body embraced between the electrodes before it returns to the battery—starting at the positive pole (the anode), circulating through animal tissue, and returning to the negative pole (the cathode). The polarity remains unchanged under all circumstances.

Muscular contractions are produced only when the current is closed or broken, or when its intensity is increased. A very weak current fails to produce muscular contractions.

The faradaic current (called also the "*induced*" or "*interrupted current*") differs from the galvanic in that it is an induced current of high tension, which is produced by the magnetizing and demagnetizing of a bar of soft iron or a bundle of soft-iron wires by means of a galvanic current.

The circuit of the generating cell is made to pass through a coil of insulated wire, known as the "*helix*," which surrounds the iron to be magnetized, *but it does not itself pass to the electrodes and thus to the patient.* Our illustration, Fig. 1, shows the construction of a faradaic machine. The thick lines represent the primary, the fine lines the secondary circuit.

Much ingenuity has been shown in the construction of the "interrupter" of a faradaic machine. It is very desirable that *slow and rapid interruptions* may be produced at the will of the operator. If a machine only insures rapid interruptions the slow interruptions can be effected by the use of an "interrupting electrode."

The power of producing electrolysis, and some other chemical properties peculiar to the galvanic current, are wanting in the faradaic.

Never attempt to combine a galvanic and faradaic battery. Separate cells should be employed for each, as the faradaic battery requires a cell of greater capacity than those used in portable galvanic machines. They may be placed in the same case, but each should be perfectly independent of the other. If a battery is designed for transportation, it is best to have one of each rather than two combined in one case.

The faradaic current is an *alternating current, i. e.*, one which goes in opposite directions at each make and break of the circuit. It is strongest when the current is broken. These facts are not generally recognized by the profession. The polarity changes with each interruption. The so-called "cathode" of a faradaic battery is felt the strongest by the patient.

Static electricity is derived by friction or by induction. A revolving plate, or by preference several plates, of glass may be employed as a generator. Static electricity is sometimes called *Franklinism.*

This form of current has high tension, but it possesses no chemical properties. When a patient is charged with it, it is necessary that the *chair upon which he sits should be insulated* by glass or rubber under the legs. When highly charged, sparks may be elicited from the body of the patient through the clothing. This is not always desirable, but it often renders its application easy, and on that account is mentioned as an advantage by manufacturers of these instruments.

Experimentation has shown that this form of electricity is accumulated upon the periphery of the object charged (as explained in all works upon physics). It apparently does not permeate very deeply below the surface.

The illustration, Fig. 2 shows a static machine in use.

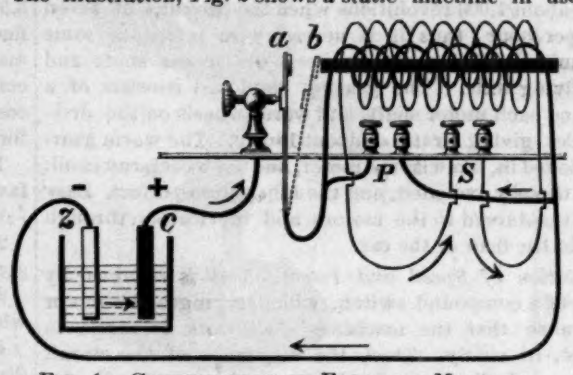


FIG. 1.—CONSTRUCTION OF FARADAIC MACHINE.

The "direct spark" is here represented as being drawn, *i.e.*, the patient being charged positively and the electrode being connected with the negative pole of the machine. No Leyden jars are employed in this form of administration of static electricity. The "indirect spark" is more commonly employed than the direct, one pole being attached, in this case, to the insulated platform, the other being grounded by a brass chain, and the electrode being grounded by a chain attached to a gas-pipe, a water-faucet, or the like. They are practically obsolete as a machine for medical purposes, as the current is unsteady when hand-power is employed.

The magneto-current (called also the "*dynamic current*") is derived from a *permanent* or *electro-magnet, in front of which an armature is made to revolve.* The armatures are composed of a core of soft iron wound with insulated wire, and the currents produced are formed within them by *breaking the lines of magnetic force.*

"Magneto-current" machines (which are turned by a crank when in use) are often sold to physicians. They are of little value. They cost as much as a good faradaic in-

FIG. 2.—APPLICATION OF STATIC MACHINE.

strument, and are not to be compared with the latter. The current generated in both is practically the same, but it is irregular in point of strength in the magneto-current machine, and uniform in the faradaic instrument.

The external resistance of a body is modified by the *length*, the *diameter*, and the *character of the conductor* employed. When any substance (such as the human body, for example) is placed between the electrodes, the resistance offered to a passage of a current by the interpolated substance must be added to that afforded by the conductors themselves. The resistance of the human body varies from 600 to 18,000 ohms. It is extremely low in subjects afflicted with general anasarca—probably because an excess of fluid renders the body a good conductor. The average resistance of the human body is not much above 2,500 to 3,500 ohms. The resistance afforded by the body is modified (1) by the saturation of the electrodes; (2) by the moisture of the surface of the body; (3) by the tissues through which the current is directed; (4) by pressure made upon the electrode; and (5) by many other factors which will be mentioned hereafter, among which the addition of salt to the water in which the electrodes are moistened is a very important one.* In cautery batteries the external resistance is increased about $\frac{1}{10}$ of a degree centigrade when the platinum wire is raised (De Watteville). Thus heat may be a factor in modifying the external resistance to be overcome.

The relative resistance of living tissues is represented by the following figures (100 being taken as the maximum): The eye, 4; muscle, 6; nerve, 10; cartilage, 20; tendon, 20; fat, 75; bone, 100; skin, 100. Thus the eye offers only $\frac{1}{25}$ the resistance afforded by skin and bone; muscle, $\frac{1}{16}$; nerves, $\frac{1}{10}$; cartilage and tendon, $\frac{1}{5}$; and fat, $\frac{3}{4}$. The epidermis, when dry, is practically a non-conductor of electrical currents.

Respecting this point, De Watteville happily remarks that "the human body may be compared to a vessel bound with a poorly conducting material (the skin), unequally packed with non-conducting solid particles, the interstices being filled up with a saline fluid of fair conductive power. The parts most densely packed with solid particles are represented by the bones; those where liquid predominates, by the muscles. Between the two are found the nerves, viscera, etc."

Before we leave the discussion of the various forms of electric currents employed in medicine it may be well to impress upon your minds some of the more important facts relating to faradaism and galvanism by means of a table in which the two are contrasted with each other. Such a table is not, to my knowledge, to be found in any work upon electricity. It may prove of service to you in many ways:

THE FARADAIC CURRENT	THE GALVANIC CURRENT
Is an "induced current."	Is due to *chemical decomposition* of one or more of the elements of a galvanic cell.
Is produced by the *magnetizing and demagnetizing* of a core of soft iron.	Its polarity is constant. The negative element of the cell becomes the positive pole of the battery.
Its polarity changes with each "make" and "break" of the circuit.	The current is a continuous one.
The current is an interrupted one.	It does not produce muscular contractions, except when the intensity is increased or when the circuit is made or broken.
It produces muscular contractions of an apparently continuous character, provided the interruptions are very rapid.	Each pole has a special therapeutical action peculiar to it under all circumstances.
The polarity is inconstant, because the currents constantly alternate in their direction.	
Is seldom administered by the so-called "polar method."	Is administered chiefly by the "polar method."
Separation of the poles intensifies the pain greatly.	Separation of the poles does not materially intensify the pain.
The "secondary current" has greater penetrating power than the "primary current." Neither equals the galvanic current in this respect.	Has a remarkable power of penetrating animal tissues placed "in circuit."
It has no chemical properties. It may be modified by an automatic commutator, so as to throw its currents constantly in the same direction as the dynamo-machine. In this case it possesses chemical attributes.	Possesses inherent chemical properties, hence its power of producing electrolysis, and its use in electro-plating, electro-lighting, etc.
A galvanometer will show only one deflection, *i. e.*, the difference in strength of the "make" and "break" currents. This deflection is the same under all circumstances when the machine is in use. It does not, therefore, indicate the strength of the current conveyed to the patient.	Produces galvanometer deflections which are proportionate to the strength of the current employed.
There is no difference in the action of the poles.	The anode is the sedative pole; the cathode is the stimulating pole.

Condensation of Fumes.

One of our recent issues contained an account of a new application of electricity, in which the discharge of the electric spark through dust and fumes caused their rapid condensation. It appears now that this fact had been observed many years ago, as a German paper which printed the article has called forth a letter from a correspondent, who states that the action of electricity on dust was known as far back as 1850. At that time Guitard published his observations as to rapid condensation of tobacco smoke in a glass, by introducing into the glass one wire of an electrical machine. Still this in no way detracts from the credit due those who first applied the principle, the more so that we believe Dr. Lodge's experiments to have been original and made without the knowledge of the older work.

* In testing this point lately by means of a Brenner's rheostat, I found the resistance from right palm to left palm, in a boy of thirteen years of age, to be 17,500 ohms, when pure water was used and the electrodes pressed firmly against the skin of both palms. Adding a teaspoonful of salt to the water and again soaking the sponges reduced the resistance to 7,500 ohms. This illustrates well the necessity for so simple a precaution when employing electric currents upon animal tissues.

The Electric Tram-Car.

At a recent meeting of the Inventors' Institute of London, Mr. A. Reckenzaun read an interesting paper giving the results of his work in the direction of running tram-cars by electricity derived from storage batteries. Mr. Reckenzaun describes the conditions to be fulfilled so clearly that their successful accomplishment is a subject of congratulation, and we cannot do better than give a *résumé* of the principal points brought out by him.

The Battery.—The first requisite for an electric car is a battery, which can be stowed away within the car. Such battery has to be of small weight, it must be reliable, supply any quantity of current according to the requirements of the road, and it must be cheaper to maintain than horse-flesh, and emit no smell. Primary batteries were out of the question; the cost of zinc and acids consumed in them would be much greater than the cost of animal power, independent of the difficulties attending the process of refilling such batteries when exhausted. The invention of the secondary or storage battery put the question entirely in a new light. Certain successful laboratory experiments at once suggested the adaptability of this invention to the propulsion of vehicles. Four years have elapsed since the introduction of the Faure accumulator into this country; it caused quite a sensation at that time, and money could be found in abundance for the exploitation of anything that bore an electrical name. Things have changed entirely since then. The original Faure battery has never been of any practical service, and very substantial improvements had to be made, at enormous costs, to bring the secondary battery to a commercial value. The Electrical Power Storage Company have acquired the patent rights of M. Faure, in addition to those of Messrs. Sellon, Swan and Volckmar, and they have, step by step, improved the mechanical details of these secondary batteries till they arrived, after fearful labors and expenses, at what may be termed a thoroughly practical article. But the prejudices created in the public mind by early failures have not quite worn off yet, and it will require something wonderful and startling to convince the public that the work of the last four years has produced remarkable improvements. None but those who have been intimately connected with the manufacture of storage batteries can form an idea as to the numerous difficulties which had to be surmounted before a permanent success was obtained. The battery was long ago perfect from a theoretical point of view, but it could not stand the test of time. Time was an essential factor; it took many months to test the durability of a set of cells, and it was only by close observation and careful remedying of defects one by one as they appeared that the storage battery assumed its present form, simple as it may appear to the uninitiated. The cell before you is one of a set of the type specially designed for tram-car work. In a lead-lined strong teak box are placed 21 lead plates, weighing together 26 pounds, inclusive of connecting strips and terminals; 10 of these are called positive and 11 negative. Each plate is formed of a lead grid, the perforations of which are filled with a paste of lead oxide; the positive plates contain thin red lead, which in charging is converted into peroxide, and the negative grids are filled with a paste of litharge, which in charging is reduced to spongy lead capable of absorbing hydrogen. We store, therefore, not electricity, but oxygen and hydrogen, which gases, by discharging the battery, manifest themselves externally in the form of electrical energy. This box is filled with sulphuric acid and water at a specific gravity of about 1.150 deg.; then a lid is put on, sealed all round the edges to prevent any spilling of acid. This acid is never removed so long as the battery lasts. There is no reduction of lead or any material going on within the cell, and the battery would last for ever but for the fact that the lead grid of the positive plates becomes so brittle with oxidation that it crumbles to pieces in the course of time; then these positive plates have to be placed periodically by new ones, but the old lead is valuable. The life of a positive plate depends entirely upon the amount of work it has done. The plates in the box before you have been at work since September last year, and they are still in excellent condition. I should say they are still as good as new; they have frequently been discharged at the rate of 100 ampères, while the average working current is 46 ampères. These cells are always being charged at the rate of 32 ampères, and the storage capacity of a cell is 150 ampère hours. Sixty such cells will weigh 1¼ ton, and propel a car with 46 passengers for about two hours over a road with ordinary inclines, curves, and 60 stoppages per hour. The diagram represents a car which has been running at Millwall and at Battersea. The accumulators are placed on trays under the seats, out of sight. These trays can be drawn out through doors at one end of the car and replaced speedily. A trolly containing a fresh set on trays and rollers is drawn up to the end of the car. The discharged cells are pulled out all together by means of a small winch, and the newly-charged ones pushed in, when the car is ready to proceed on its journey. There are three sets of accumulators to each car—two sets charging while one set propels the vehicle; thereby time is saved and waiting prevented.

The Electromotor.—The machine has to convert the electric current into mechanical power. For tram-car propulsion it is absolutely necessary that the motor should have a high efficiency, and at the same time be of small dimensions and little weight. To combine these requirements has been the aim of the author, and he has at length produced a machine (shown on the diagram) which has had some rough tests in actual service under the most trying circumstance and conditions. There are two motors driving the car, each capable of working up to nearly 9 horse-power, and weighing 420 pounds. Each motor is supported independently upon a small bogie, the whole mechanism is self-contained, and each separate bogie forms a small locomotive engine upon which the car rests. One axle of each bogie is a driving axle; thus we obtain four small driving-wheels, which give the requisite grip upon the rails. Either bogie can be detached from the car in less than one hour, so that in case of repairs and inspection the motor can be taken out and replaced without letting the whole car stand idle for any length of time.

The Gearing.—The speed of the motors is necessarily high—about 1,000 revolutions when the car runs at seven miles per hour; thus it is necessary to introduce some mechanical reducing gear between the motor shaft and the driving axle. The gearing employed consists of a worm on each motor shaft, and worm wheels on the driving axles, giving a ratio of about 1 to 12. The worm gearing is boxed in, likewise the motor, and the wheels run in oil; dirt is thereby excluded, and the lubrication perfect. Easy access is obtained to the motors and lubricators through doors in the floor of the car.

Variation of Speed and Power.—This is obtained by means of a compound switch, which arranges the motor circuits so that the machines shall work in series, in parallel, or singly. Thus, the resistance of the circuit being varied, the power and the speed very accordingly. When a greater range of speed is desirable, the motor circuits are still further divided by arranging the field magnet wires apart from the armatures. This obviates cumbersome gearing, which would add to the weight and expense, increase first cost, as well as maintenance. The driver has full command over the motive power; one handle suffices for all the operations of starting, stopping, and varying the speed or power. There is no useless electrical resistance, and therefore no waste of energy, whatever speed the car may be traveling at. The car is provided with these details at both ends, so that the driver has merely to remove the handles and two connections at the end of a journey, and then proceed. It would be an easy matter to vary the speed by decreasing or increasing the number of cells, and thereby vary the electromotive force. This method, however, is injurious to the accumulators, because some of the cells would be discharged sooner than the others, and when they are all recharged in series some would have to be very much overcharged before the rest could receive their share. There would not only be a waste of power occasioned by the evolution of gases for no purpose, but the life of the cells and their efficiency are reduced by this irregular treatment.

Brake Power.—At each platform there is the usual vertical shaft and brake handle. A chain is wound upon this shaft when the handle is turned and eight brake blocks are simultaneously pressed against the corresponding number of wheels. The car can be stopped in an instant. Besides this, there is an electrical brake, so that the motors act as dynamos driven by the momentum of the car, or running down an incline; the whole of the power stored up in the momentum of the car is converted into electricity, and the current generated is utilized in magnetizing the brake blocks, thereby increasing their grip upon the wheel tires. Arrangements are being made to render this electric brake automatic, so that the main circuit will be broken and the brake circuit with the motors closed automatically when the speed of the car reaches a certain maximum.

Cost of Motive Power.—It has been mentioned that the capacity of the tram-car cell is 150 ampère hours. We do not exhaust them entirely, but leave a margin of about 20 per cent. in the cells, 120 ampère hours' charge being sufficent to propel the car full of passengers for two hours, or about 12 miles, over an average road with frequent stoppages. When charging 60 cells at the rate of 32 ampères for four hours, and replacing the accumulators in the car every two hours, we require steam power to the amount of about 15 indicated horse-power per car. Assuming that the car has to run 72 miles in a day, and that we are supplying several cars at the same time from one engine, the fuel consumed need not exceed 4 lbs. per indicated horse-power per hour. The charging takes place during 12 hours of the day only; thus 7 cwt. of coal per car per day will give a consumption of about 10 lbs. of coal per mile. Reckoning the price of coal at 18s. per ton, the fuel per car mile would cost less than one penny. By working longer hours we could do with less engine-power, but, of course, with the same consumption of coals per car mile. The most economical steam tramway locomotives burn from 9 to 12 lbs. of coal per mile, or about the same as quoted for the electric car. There are two reasons for this high consumption—firstly, the steam locomotive weighs four times as much as the accumulators, electric motor and driving gear, therefore it requires greater power for its own propulsion; and secondly, a tramway locomotive boiler and engine cannot be expected to compete with a large stationary engine and boiler as regards economy. Thus the loss arising from the conversion of steam power into electricity, and the reconversion of electricity into mechanical power, is more than compensated for by corresponding advantages. There are instances when water power is available within a reasonable distance from the tramway depot, and in such instances the additional economy will be apparent.

Prime Cost, Maintenance and Depreciation.—The steam engine, boilers, dynamos and shafting, and all necessary apparatus for a charging station, to supply a dozen electric cars, including spare power, will cost £4,000; and the complete equipment of 12 two-horse cars, inclusive of ample spare gear, may be estimated at £6,000. The superintendence of machinery at the charging station will cost £1,100 per annum; fuel (at 18s. the ton), water, oil, and waste, £1,400; 10 per cent. depreciation on engines, boiler, and dynamos, £400; and with an estimated depreciation of 35 per cent. on the whole propelling apparatus, we get a total expenditure of £5,000 per annum, which is equivalent to 3.5 pence per car mile run. You will observe that these figures are thoroughly reasonable, and allow of a good margin. We should have to almost annihilate the whole concern at the end of a year in order to bring the working costs to an amount allowed by some tramway companies for horsing.

The following is a summary of the principal points in favor of this system:

1. Economy in running cost.
2. The electric car has the same appearance as those in general use, and any ordinary car can be readily converted.
3. The wearing parts of the mechanism driving the wheels are few in number and easily replaced.
4. The weight of the motive power is less than two tons, distributed over two small bogies.
5. The propelling apparatus is invisible to the passengers, practically noiseless, clean and free from danger.
6. One man (not necessarily skilled) can drive the car.
7. The car may be illuminated at night by the electric current, sufficiently to enable the passengers to read comfortably. The power required to maintain the electric light is so small that the cost may be neglected from the estimates, for the lamps (giving together 40 candle-power) consume only three ampère hours out of 150 given by the cells.
8. The maintenance of the permanent way (paving) must be less than in the case of tramways where horses are used, the hoofs of which follow always in the same tracks.
9. The space required for a charging station for the secondary batteries is much less than that necessary for stables for horses to do the same work.
10. The same plant which charges the storage batteries may be utilized for lighting the depot and even buildings in the neighborhood.

The Protection of Inventions by Patents.

To the Editor of The Electrical World:

SIR: Will you please answer the following question through the columns of THE ELECTRICAL WORLD? Can one patent be made to cover the modifications of an invention which Mr. Thompson speaks of in the discussion of Mr. Jannus' paper; or must the inventor apply for a patent on each modification? B. BUYS.

FLINT & PERE MARQUETTE R. R., July 7.

[The subject-matter of this question is of so much importance to the successful protection of inventions and to inventors and patent solicitors, that it may well be considered at some length.

From a review of inventions thus far patented and set forth in letters patent, there seem to be four classes of inventions, as follows:

1. Primary Inventions. Any new composition, process or device which accomplishes successfully one or more results never before obtained, constitutes a primary invention. The phonograph comes under this definition, because it was the first practical device ever constructed by man for reproducing articulate speech. The telephone falls under the same definition, because it was the first practical device ever constructed for transmitting articulate speech to a distance. The electro-magnetic telegraph, the first sewing machine, the differential electro-magnet, are further examples of primary inventions.

2. Secondary Inventions. Any new and successful composition, process or device for accomplishing an old result is a secondary invention. For example, all the telephones invented since the first, all the phonographs invented since the first, all the arc lamps invented since the first, are secondary inventions.

3. Modifications. Any new and successful change in the proportional weights of the ingredients of a composition; any new and successful change in the order or number of steps in a process, or any new and successful change in the form, combination or disposition of the elements or parts of a device, is a modification of the primary or secondary invention, as the case may be, provided such changes do not relate to the composition, process or device as an entirety, for in such cases the modification is so comprehensive as to constitute an entirely new and successful means for accomplishing the result, and becomes a secondary invention.

4. Supplementary Inventions. These are primary or

secondary inventions which are adapted to accomplish objects necessarily created or suggested by any other primary or secondary invention. For example, the telephone switchboard, the telephone supports or body gear, the arm rests for telephones, the anti-induction systems, the tools for making certain parts of telephones, all the attachments to telephones for intensifying the sound, are supplementary inventions to a telephone.

In the discussion referred to, the word "modification" improperly included the last three classes; the word "derived" is suggested, to include all classes of invention except the primary.

The answer to the proposed question naturally divides itself into parts, which are not given in the form of law, but simply as suggestions to inventors and solicitors.

1. Every primary, secondary and supplementary invention should each form the subject-matter of separate applications for letters patent.

2. If it is desired to have a specific claim for each or any of the modifications of a primary, secondary or supplementary invention, each of said modifications should form the subject-matter of separate applications for letters patent.

3. In general, every distinct invention should form the subject-matter of a separate application for letters patent.

The apology for putting so much importance upon the preference of separate letters patents, is that a majority of the decisions in patent suits at law show that a man's invention is worth only what is shown in the claims at the end of his specification.

The above considerations are as specific as it is safe to make them. In individual cases, the answer should be given by a competent solicitor of patents, after a careful investigation of the inventions.

The United States law is much more particular (and for good reasons) in this respect than that of England and most other countries. For example, an invention in our hands at present requires, according to the United States Patent Office, five patents, while it is covered in England by one patent. In another instance, we now have pending three telephonic English patents in the shape of seven United States applications for letters patent. On the

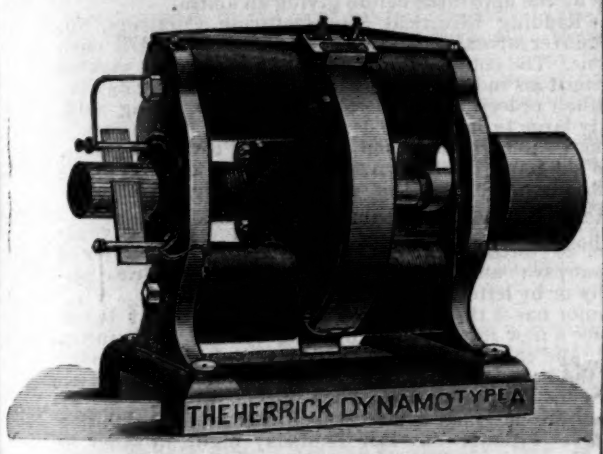


FIG. 1.—THE HERRICK DYNAMO.

other hand, there are numerous cases where one United States patent will cover everything which the inventor at all wishes to claim.—ED. PAT. DEPT. E. W.]

Pacinotti vs. Gramme Armatures.

BY R. S. DOBBIE.

Seeing in one of your recent issues a query regarding the relative merits of a Pacinotti ring armature and that of Gramme, I thought it would not be out of the way to give a little experience that occurred to me in the course of a research that involved the use of a motor.

Having a field for an armature 60 mm. in diameter, and 70 mm. long, I made no less than thirteen armatures of different patterns but all of the same general kind, viz., the Gramme ring. Two of these were practically identica in resistance and number of convolutions; and these I subjected to careful comparative tests. Briefly, *the weight of zinc* consumed for the same *work*—in this case lifting a heavy weight by gearing—was as follows:

Pacinotti	.63
Gramme	1.00

I would point out that the clearance of the Pacinotti ring, measuring over the teeth, was ½ mm. (that is, difference of diameter of armature and field = ½ mm.), whereas the Gramme had 1 mm. clearance, measuring over convolutions.

I suggest that the close proximity of the *iron* of armature to the field was the cause of the superiority of the toothed armature. I hope to hear further on this subject from others who have given it attention.

[We join Mr. Dobbie in the hope that others will communicate their experiences in this direction. The subject is one of importance, and no critical experiments have ever been made, we believe, to determine the true value of different armatures. It is true that practical experience may be consulted in this matter, but the conditions vary so much that a fair deduction can hardly be made in this way. Mr. Dobbie has followed the correct method of procedure in making the conditions as nearly alike as possible, and from his experiments it would appear that the Pacinotti ring was the most efficient. Without knowing the full details of the experiment, we can, of course, express no opinion regarding the exactness of our correspondent's work; but from what he states, a clue may be obtained of the value which such a series of experiments would possess.—EDS. E. W.]

Indiana Aroused.

At a meeting of the managing committee of telephone subscribers, held at Indianapolis last week, it was decided to intrust the duty of properly testing the new telephone law in the courts to prominent legal talent, among whom are Addison C. Harris, W. H. Calkins, Judge Howard and others. The committee also decided to engage eminent counsel outside of that city.

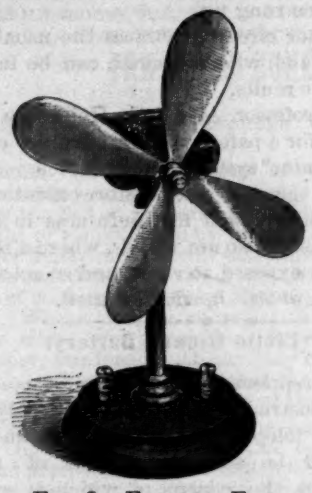


FIG. 2.—ELECTRIC FAN.

The committee has issued the following circular, which is being distributed throughout the State:

INDIANAPOLIS, July 20, 1885.

To Telephone Subscribers in the City and State:

The managing committee recently appointed by the contesting telephone subscribers propose to press vigorously the duty of giving the new telephone law a strong support in the courts. It is believed that the law is fair and valid, and that the company can very well afford to render telephone service of acceptable character for the reduced rate fixed. We therefore call upon all telephone subscribers to contribute toward the expense of vindicating the new law, and as the sum needed must necessarily be large in order to enable us to secure counsel able to cope with the large array retained by the company, we hope the subscribers will be liberal, and that all citizens in sympathy with our effort to uphold the statute will do something to aid the cause.

JOHN W. MURPHY, Chairman.
J. A. HOLMAN, Secretary.
L. S. AYRES.
JOHN E. SULLIVAN.
R. O. HAWKINS.

The "Eureka" Dynamo.

Our illustration represents a dynamo designed for domestic electric lighting. The machine, Fig. 1, is constructed in a simple manner, so that the most inexperienced can handle it, and type *A*, shown in the engraving, is capable of furnishing 8-12 c. p., incandescent lamps, or 1-1200 c. p. arc lamp, requiring a one horse-power engine to run it. A second size, type *B*, has double the capacity of the first, furnishing a current of 24 ampères at 40 volts.

These machines and all necessary accessories are made by Messrs. Guimaraes & Herrick, of this city, who also

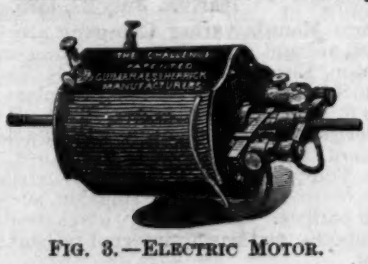


FIG. 3.—ELECTRIC MOTOR.

manufacture a number of other electrical novelties. Among the latter is the fan shown in Fig. 2, which will prove a welcome addition to the regular desk furniture in this hot weather. The "Alaska," as it is called, stands 14 inches high, and is supported by a nickel-plated brass upright, mounted on an iron base.

In one of our recent issues we illustrated a patent relating to an electric motor in which the armature had three branches. The manufacture of this machine has been undertaken by Messrs. Guimaraes & Herrick, and our illustration, Fig. 3, shows the motor adapted for running sewing machines, printing presses, jewelers' lathes, large fans, etc. The construction of the motor is such that it has no dead point, and a spring adjustment is provided by means of which the brushes may be maintained in any required position, and the speed of the motor governed accordingly.

We also illustrate a medical battery, Fig. 4, made by the same firm, which is specially designed for home use.

Wires and Magnets.

To the Editor of The Electrical World:

SIR: 1. Will you be so kind as to give me formula for size of wire to use in coils to carry any given current without heating too much? 2. If I have a magnet excited by a current of 2 ampères in a coil of 100 turns, what number of turns must I have to get the same magnetic strength with a current of 1 ampère? Will not 200 be right? A. H. BURNETT.

ANS.—1. Let C = current in ampères.
" R = resistance of wire.
" H = number of heat units.

then $$H = \frac{C^2 R}{4.16}.$$

For the benefit of those not prepared to apply the above formula, it may be remarked that in wires smaller in diameter than No. 14, 5 to 6 ampères may be carried per square millimetre of cross section, while for wires larger than No. 14, 3 to 4 ampères may be carried per square millimetre of cross section.

2. The magnetic strength is proportional to the number of turns, consequently, double the number of turns will require but half the current of the same electromotive force to produce the same magnetic effect.

Trouve's and Skrivanoff's Batteries.

To the Editor of The Electrical World:

SIR: Can you give us a fuller account of Trouvé's experiment or a more detailed description of the Skrivanoff primary battery, so we can fix up one? We have no electric light here owing to strong gas opposition, and I want a small plant of my own. P. HELMER.

CLINTON, Ia.

ANS.—Trouvé's domestic battery charged ready for working weighs 3.5 kilogrammes (7¾ lbs.), contains 6 bichromate elements in series, each one of which consists of 1 zinc and 3 carbon cylinders, with a provision of 100 cubic centimetres (6 cubic inches) of solution. The weight

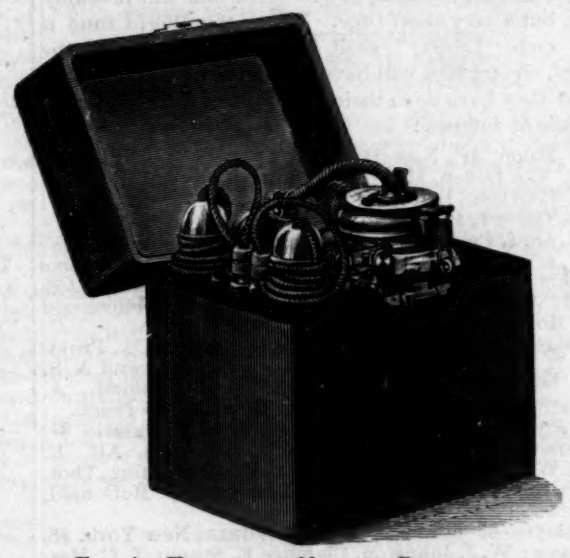


FIG. 4.—HOUSEHOLD MEDICAL BATTERY.

of each zinc cylinder amalgamated with from 8 to 10 per cent. of mercury, is 85 grammes (1,312 Troy grains), or 500 grammes (1.1 lb.) for the 6 elements. The E. M. F. is 1.9 volt and the resistance in series on the lamp yields an available current, at the terminals, of 8.4 volts at 1.2 ampère per element. The larger form of Trouvé's battery is described fully in Niaudet's "Electric Batteries." Skrivanoff's battery is composed of a prism of carbon covered upon its face with chloride of silver. The carbon thus prepared is immersed in a solution of potassic hydrate dissolved in water. Near the carbon is placed a plate of zinc. It is preferable to surround the chloride of silver with a porous cloth to prevent it from falling away from the carbon. The E. M. F. is 1.5 volts per cell.

Batteries and Keys.

To the Editor of The Electrical World:

SIR: 1. Please tell the difference between a gravity battery and a Daniell battery, and how each is made up. 2. When any one is calling on the wire, if you open your key and cannot break him, is there any other way this could be caused besides the key at your instrument being wet?

Yours truly, EDW. WINDSOR,
North Garden.

ANS.—1. The difference between a gravity and a Daniell battery consists in the fact that the former has no porous jar; the difference in specific gravity of the two liquids (sulphate of zinc and sulphate of copper) keeps them separate. You can obtain full information in regard to the construction and maintenance of these and nearly all other batteries from Niaudet's "Electric Batteries," to be had at this office.

2. Perhaps the insulation around the lower contact point has become defective; or your instrument may have a hidden cross connection, either of which would act in the manner you describe. Examine your instrument carefully and keep it dry and free from dust, which is apt to accumulate moisture in damp situations.

WIRE COMMISSION JOYS.

Oh, nice is the place and snug is the berth
Of him who can hold a position
So kindly connected with Mother Earth
On the Underground Wire Commission.

His deeds he may hide in a trench if he will,
His conscience the same way concealing,
While over his head the wires wave still,
And from this there is no appealing.

The rule of his life may be How Not to Do,
With nothing his notions to fetter;
He is paid by the people this course to pursue,
And the less he may do, the pay's better.

Behind him a monster Monopoly stands,
And its shadow completely hides him
As deep in its pockets it thrusts its hands
And freely with cash provides him.

And thus may Monopoly's team, you see,
Its load of corruption still drag on,
Till the people arise in their majesty
And bury the mules and the wagon.

In the meantime, the berth is a very nice place
For a small or a big politician
Who wants to do nothing, by corporate grace,
On an Underground Wire Commission.

"The Electrical World" Bartholdi Pedestal Fund.

Below we publish our fourth list of contributors to the above fund. As will be seen from this and the lists heretofore printed—and taking into account the sums acknowledged in the New York *World* from electricians and the employés of electrical houses prior to the establishment of "THE ELECTRICAL WORLD" Fund—those engaged in electrical pursuits have contributed handsomely to this worthy cause. For ourselves, and also on behalf of the New York *World*, to whom we turned over the amounts subscribed to our fund, we cordially thank electricians for this generous response. The *World* fund is now within a little over $1,000 of the required $100,000, and the securing of this small sum will probably require but a very short time. When the *World* fund is closed and "Liberty" shall have been placed on the pedestal, electricians will have the consciousness of knowing that they have done their full share of the good work. The list is as follows:

C. O Baker, Jr., Newark, N. J., $10.
A. C. Van Doven, Helena, Montana, $2.
L. S. Morrison. Bellevernon, Pa., $1.
A. T. Gifford, Hopedale, Mass , $1.
E. H. Goff, Pres. American Electric Manufacturing Co., $25.
Through E. J. Molera, San Francisco, Cal., $2.50, as follows: E. J. Molera, $1; Amelia Molera, Fanny Molera and Annie Molera, 50c. each.
Employés of Rhode Island Braiding Machine Co., Providence, R. I., $2.25, as follows: G. K. Winchester and A. S. Hood, 50c. each; J. A. Simmons, B. B. Edmonds, A. P. Winchester, J. F. Hills and A. T. White, 25c. each.
Employés of Bell Telephone Co., London, Ontario, $1, as follows: J. E. D. Crawford, B. I. Throop. Alf. R. Baker, W. H. Baker, John Livesley, Frank Whiting, Thos. W. Whiting, Ed. Hanson, R. McCarthy and D. McDonald, 10c. each.
Employés of THE ELECTRICAL WORLD, New York, $8, as follows: W. J. Johnston, Clarence E. Stump, T. C. Martin, E. P. Thompson, Joseph Wetzler and Thaddeus Davids, Jr., $1 each; Walter T. Hunt, 50c.; R. D. McCartie, George R. Macey, A. Menzies, B. Jordan, L. McLaughlin and George Buchanan, 25c. each.
Through A. D. Bethard, Superintendent Telegraph, Richmond, Va., $12.25, as follows: A. D. Bethard and John Caskie, $1 each; J. Wyatt Dawson, 75c.; B. H. Slaugher, W. B. Brown, S. P. Haeley, T. A. Taylor, U. H. Oakey, W. W. Pendleton, J. E. Briggs, J. A. Burgess, J. M. Starritt, J. J. Perkin, Geo. D. Akers, Geo. B. Goss, R. H. Pannill, W. A. Taylor. M. S. Bowles, J. C. Stone, W. D. Green, Chas. P. Knight, 50c. each; R. O. Denpree and O. B. Payne, 25c. each.

The Electric Light in Newspaper Offices.

Last week we quoted the warm praise given by the New York *Sun* to the incandescent light after having tried it for some time in its establishment. Since then we have received a letter from the Courier Company, of Evansville, Ind., which uses the United States system, and for which it offers strong advocacy. The *Sun* made a clear showing in favor of the incandescent lamp on hygienic grounds; the *Courier* makes an equally good showing on economic grounds. Both sides of the case must be presented to consumers and the public. Here is the letter in full:

"We have a 30-light United States plant in our office, which we put in about the first of February. For the benefit of newspaper publishers we wish to give a statement of what the cost has been to us and how much can be saved by using the incandescent lamps in place of gas. We had a good engine and boiler, and hence had no expense in putting in plant except cost of dynamo, wires, wiring and lamps. Our coal bill has been increased $10 per month. Cost of lamps (600 hour guarantee), $15 per month; attendance, $15 per month; making total cost of 30 lights (we have 36 in, but do not use them all at any one time), $40 per month. Gas at $2 per thousand would cost from $80 to $100 per month. Coal oil, including breakage of lamps and chimneys, and attendance had been costing us over $35 per month. So publishers who have the power will find the incandescent lamp the best and cheapest, and the United States and Weston lamps the best. We have written the above communication unsolicited by the United States Company, and submit it to you for publication or the waste basket, as you may decide."

The Electrical "Communicator."

In our issue of July 18 we described the "automatic responder," an attachment for the telephone, since which time a modification of the apparatus used in that invention has been devised, which has been ingeniously adapted to the use of hotels and apartment houses, as well as offices or private residences. This has been called the "communicator," its purpose being to convey immediately the different wants or calls of the occupants of the rooms. It registers the same, so that the janitor or call-boy may at once supply the need without any delay, thus obviating the necessity of sending to the caller to ascertain the object of the call when rung up.

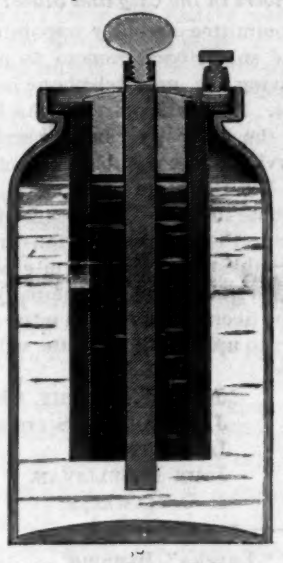
The communicator circuit embraces the usual call-bell and annunciator, and, where desired, can be introduced into their existing circuits.

The inventor, Professor Alfred G. Holcombe, of New York, has applied for a patent on the novelties contained in the "communicator" system.

Aside from the general uses before mentioned, the "communicator" has a field for usefulness in factories, mines, railway trains, or steam vessels, where a register of the orders may be exposed to view, and so act as a confirmatory indicator of the signals now used.

The "Little Giant" Battery.

Our illustration represents a new form of open-circuit battery of novel construction, which is eminently adapted for gas lighting, telephone, electric bell and similar purposes. It will be seen to consist of a hollow tube of carbon, in the centre of which is suspended a rod of zinc. This gives a large surface and greatly reduces the internal resistance of the cell, which is given as 1 06 ohm, with an E.M.F. of 1.25 volt. The battery, which is made by the Rhode Island Telephone & Electric Company, of Providence, R. I., is very



THE "LITTLE GIANT" BATTERY.

compact in form, the large size measuring 6 inches by 3½ inches, and the smaller 3 inches by 1¾ inches.

Besides its use as an open circuit battery, the cell is well adapted for use with bichromate of potash solution, its convenient form making it easy of access for cleaning and replenishing of liquid.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, July 27, 1885.

The Mayo Electric Manufacturing Company are doing the wiring for both arc and incandescent lighting on the plant of the Taunton Electric Lighting Co., at Taunton Mass. The Brush-Swan system is used on this plant.

Messrs. Keenan & Wilson, No. 40 State street, Boston, are perfecting a series of open and closed circuit acid batteries. One form of their acid battery remained, it is claimed, on a closed circuit of 75 hours without exhausting full strength of an ordinary bichromate solution, such as is used in a Bunsen battery. This battery gives over three volts and four ampères, and has an internal resistance of less than one ohm.

The council representing the three companies—viz., Brush, Merchants' and New England Western—are at work drawing up the articles of incorporation under the laws of Massachusetts, which, when complete and duly recorded, will set at rest any doubts as regards the consolidation of the companies above named. The corporation, which comprises the three companies referred to, will meet for organization on Monday, August 3. They will then decide on the personnel of the company and the board of directors for the coming year.

Mr. Theodore N. Vail has decided not to take his departure for Europe until late it the fall, owing to the importance and multiplicity of business engagements which demand his attention during the next six weeks or two months.

On the 21st inst. the Peruvian Construction and Supply Company shipped from Boston its second large consignment of electrical apparatus for Lima, Peru. Another shipment will be made on August 1.

Messrs. T. C. Frenyear & Co., 352 Washington street, dealers in electrical goods, will issue about August 1 their monthly trade bulletin, containing latest prices of staple articles used in the trade. On the 15th of August they will issue their first illustrated catalogue, which will be sent free to any address. This firm is making, as one of its specialties, a line of finely finished push buttons.

The business of the Thomson-Houston International Electric Company is looking up very satisfactorily. They have now established agencies throughout the whole of Europe, and the demand through same for the apparatus made by them is constantly increasing.

The Judkins Railway Train Signal Company have given an order to the American Electric & Development Company, of this city, for the manufacture of one thousand sets of their apparatus.

Last May, Mr. N. J. Simmons, of Woburn, Mass., ordered a small Edison central station to be installed in his machine shops in that town for the purpose of lighting them, together with the skating rink and several residences of his neighbors. What Mr. Simmons was about to do soon became generally known, and the idea of using the electric light met with so much favor that the entire working capacity of the plant was sold before the starting up. Mr. Simmons has shown a commendable spirit in undertaking this enterprise alone. The gas company of Woburn, on learning of the move made by Mr. Simmons, reduced the price of gas, but this did not interfere with the sale of the electric light, as the sanitary advantages and cleanliness more than compensated for the difference in price. The New England Wiring Company has had charge of the installation of this plant, and has done its work with promptness and dispatch, to the satisfaction of Mr. Simmons and the Edison Company. On Tuesday evening, July 21, the plant was put in operation, and electric light furnished for the first time in Woburn. A very large gathering of enthusiastic citizens witnessed the starting, and everything worked satisfactorily.

The Lewiston & Auburn Electric Light Company, Auburn, Me., use 107 arc lamps of the Thomson-Houston system, and average 6½ hours each night. They have two 50 H.-P. Armington & Sims engines and one tubular boiler set with the Jarvis patent furnace.

Mr. Parker, the General Superintendent of the New England Telephone & Telegraph Company, returned to this city last week, after a pleasant visit to his farm in the State of New York.

The latest invention made for the improvement of navigation of vessels of all kinds is the Electro Polargraph, and its inventor is Mr. Henry A. Chase, of Stoneham, Mass. The principal object of this invention is to insure greater safety to a vessel where the course lies near land or dangerous shoals. It is so arranged, when applied to a vessel, as to ring out a loud alarm in the captain's cabin when the man at the wheel neglects his work or the vessel goes out of her regular set course. In the latter case, a certain allowance for leeway, either to the starboard or port, is made by the apparatus before giving an alarm.

The Redding Electrical Manufacturing Company, No. 30 Hanover street, is making a specialty of electric push buttons. The company are now busily engaged in making these buttons in large quantities, but are considerably behind their orders, their liberal facilities not being sufficiently large to supply the demand growing upon them.

A new enterprise has been started in Providence, R. I., under the name of the Synchronous Time Company, having in view the object of giving perfectly reliable time from a general centre of distribution.

The offices of the Tarbox Time Register Company are at No. 20 North street. Mr. L. W. Pennell is treasurer of the company, and will be pleased to answer inquiries personally or by letter.

Rumor has it that the Brush Company are about to introduce a new incandescent lighting system at Taunton, Mass., and that arrangements have already been effected with the Para Rubber Co., at South Framingham, Mass., for the installation of this system in their works.

The Edison Company, of Boston, started an exhibition plant at Rutland, Vt., last Thursday night, in order to show the citizens of that town, the majority of whom had never witnessed incandescent lighting, what an Edison light really is. This company would have operated a plant in Rutland some time ago, but the enterprise was retarded by the skepticism on the part of many of the leading citizens of that town as to the ability of the incandescent light to compete with the gas used there, which is of the most excellent quality. After running the trial plant for three nights, the unanimous verdict was in favor of the incandescent light, and the proposition of the Edison Company, which had been previously made, was instantly acted upon and accepted. The installation of the plant, consisting of 250 lights, will be commenced at once. The wires will be run on poles, and the installation will be made on what is generally known as the Edison three-wire system. The New England Wiring Company, of Boston, will do the wiring and other work necessary to place this plant in proper working order.

Mr. C. L. Bly, of Boston, has just completed a new fire-alarm system at Bradford, Mass. It is working satisfactorily to the fire department of that town.

The Remington Electric Lighting Company, through their New England agents, Messrs. J. N. George and A. P. Burdett, have just installed a new 40 arc-light plant at Crescent Beach, near this city, which is reported to be working satisfactorily. This is the first plant installed by the Remington Company in New England.

PROVIDENCE, July 29, 1885.

The R. I. Telephone and Electric Company report business with them as being satisfactory. Their system of electric time clocks has long ago proven an assured success, and the company to whom they recently sold the State right has already one thousand subscribers. Their watchman's clock is the only one of the kind having magneto stations. Attached to this system is an alarm bell, which is placed in the residence of the superintendent to notify him of any neglect on the part of the watchman. This company are highly gratified with the large number of orders they have received for their "Little Giant" battery. They are at present engaged on several novelties in the electrical line.

It is gratifying to learn that the Armington & Sims Engine Company are now very busy filling orders for new electric light plants in all parts of the country.

The Narragansett Electric Lighting Company have been awarded the city lighting on the new apprizal, having successfully fulfilled their past contract. The incandescent system of this company is rapidly gaining in favor.

The business of the Baltimore & Ohio Telegraph Company in this section is increasing so rapidly that they already contemplate moving into larger and more commodious quarters. Mr. C. J. Sheehan, the Assistant Superintendent of the Eastern Division, is highly elated over

the shape the affairs of his company have taken in New England.

The R. I. Electric Power Co., operating in this State under the Daft system, is running a 10 H.-P. generator in this city, and furnishing power for the forges and atmospheric hammer in the engine works of the Harris-Corliss Co., the R. I. Printing Co. and the Hope Glass Cutting Works, and in each case giving absolute satisfaction. They are making preparations to put in a 50 H.-P. generator.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, July 27, 1885.

Underground work in Chicago is proceeding at a rapid pace now. The conduit company is extending its conduits, and the electric light, telephone and telegraph people are all the while getting more and more of their wires beneath the surface.

The latest in this direction is by the Chicago Telephone Co., which is making arrangements to put a large number of its wires under ground. With this end in view, it has just let two large contracts for cable, one to the Western Electric Co., and one to the Standard Underground Cable Co., of Pittsburgh.

The Western Electric Company have the contract for the south and west sides, and the order calls for upward of 400 miles of conductor, to be furnished in fifty and hundred-wire cables.

At the telephone office on the west side, at the corner of Desplaines and Washington streets, some 900 aërial wires will be done away with. From this office cables of 100 wires will be put down to the corner of Clinton & Harrison, 100 to Desplaines and Monroe, 200 to Green & Madison, 100 to Green and Lake, 150 to Desplaines and Lake, and 250 others.

On the South side the work is from the office at Twenty-second street, from which cables for 150 wires will run to Twenty-third and South La Salle, and 150 to Sixteenth street.

The Standard Underground Cable Company have the contract for the North side, calling for 190 miles of wire. From the office at corner Chicago avenue and Clark street cables for 150 wires will be run to Chicago avenue and State street; for 250 wires to Chicago avenue and Wells; for 100 to La Salle street tunnel.

The cable laid by the Chicago Telephone Company will not go into the conduit system, but a wooden box will probably be laid in a trench, the cable laid in the box, and the box then filled with cement around the cable.

Underground work received another lift this week, in an order given by the local conduit company to the Western Electric Co. for a twenty-seven wire cable, to be some two miles in length. It is the intention of the conduit company to put this cable in their conduit, and rent the wires to whoever wants them for telegraph, telephone and fire-alarm use.

This cable will be laid so as to cover the principal business portion of the South side, and will be extended as the circumstances may warrant.

Arrangements have been made for cheap power to the coming electric light convention, and inquiries in regard to same should be addressed to Mr. Geo. S. Bowen, care Van Depoele Electric Manufacturing Co., Chicago.

The Western Electric Co. pays a quarterly dividend of 1½ per cent. on August 1.

The city of Winona, Minn., has closed a contract for the lighting of that city with 60 Van Depoele lights for the term of five years.

The contractor will also put in 40 additional lights for private lighting.

The Van Depoele Co. have just secured a contract for building an electrical railway at Toronto, Ont., to carry the passengers to the coming Industrial Exposition there. The railway which the Van Depoele people had there last year was only an experimental one. It is said to have been a perfect success, however, and to have carried 200 passengers to each train. The present road will be extended to the city and run in connection with the city railways, and is to become a permanent institution.

Mr. J. A. Wetmore is at present giving Western people an opportunity to examine the wires and cables of the Okonite Company, of 13 Park Row, New York. Some of the features of the company's products are the Okonite saturated braiding, used as a protection from moisture; flexibility, high insulation and comparatively indestructibility of the insulation, and in the case of cables, comparative lightness. This last point will not be lost sight of by people wanting cables for aërial use. Mr. Wetmore reports a good trade and a favorable reception for his goods.

THE TELEGRAPH.

The Telegraph Fight.—There are new developments in the telegraph litigation between the Western Union and the Bankers & Merchants'. At Willimantic, Conn., the former demanded of the Bankers & Merchants' Company four American Rapid wires, and they were given up. Subsequently the Western Union Company demanded 16 wires from Hartford to Boston, and four from Willimantic to New London, but the lawyers and sheriff, in behalf of S. & J. Johnson, who have an attachment upon the property here, refused the latter demand until further orders.

Not to Have a Monopoly.—At the instigation of the Western Union Telegraph Company, which owns the Gold and Stock Telegraph with its "tickers," efforts have been made for the past month or two to have the "tickers" of the Commercial Telegram Company thrown out of the New York Stock Exchange, thus giving the Gold and Stock the exclusive privilege of the Exchange. A vote of the Governing Committee was taken on Friday, when, by an almost unanimous vote, it was decided that the Commercial was entitled to precisely the same privileges in the Exchange as the Gold and Stock. It will be remembered that some months ago President Grier reduced the price of his "tickers" by one-half, and publicly stated that he "would make short work of the Commercial Company." The purpose has, obviously, not been accomplished.

Damages Against Western Union.—Upon the report of Referee James C. Spencer a judgment was entered last night in the Superior Court in this city against the Western Union Telegraph Company and in favor of James H. Goodsell for $240,159.11. In January, 1881, Mr. Goodsell a President of the National Associated Press, made a contract with the Atlantic & Pacific Telegraph Company for the dissemination of news. The contract went into effect on Feb. 1, 1881, but on Feb. 3 the Atlantic & Pacific Company fell into the hands of the Western Union Company, which assumed to carry out its contracts. The Western Union Company in 1882 charged Mr. Goodsell greater rates and stopped their service because he refused to pay them. In July, 1882, Mr. Goodsell brought suit against the Western Union Company to recover $22,000, which, he alleged, the company had collected from different newspapers for his service and had failed to account to him for. He also asked for damages to the extent of $650,000 for a breach of contract. The Western Union Company alleged that the contract was invalid and fraudulent, and that a new arrangement had been made and carried out, but that finally Mr. Goodsell abandoned the work. For this they put in a counter claim for $15,000 damages. Of the judgment entered on the referee's report $220,306 is for damages and $16,777.42 for money due, the rest being interest.

THE TELEPHONE.

The Southern Bell Telephone Company operates forty-five exchanges.

Telephone Wires—Liability of Company.—A telephone company may be held liable for an injury to a passer by the fall of its wires in a public street caused by the weight of ice produced by water thrown upon them by a city fire department while extinguishing a fire, according to the decision of the Supreme Court of Minnesota in the case of Nichols vs. City of Minneapolis, decided on the 9th ult. Where such a company is given a license to string its wires over the public street, it is, in the opinion of the court, burdened with the duty of maintaining those wires in a safe condition, so that they may not become nuisances or endanger the safety of the traveling public.

Erie Prospects.—Erie telephone shares have started up grade. The rise appears to be based on the improved condition and prosperty of the company. A debt of $230,000 a year ago has been reduced to $78,000, and the $14,000 net which the company is earning is expected to so far cancel the remnant that dividends can be resumed on a conservative basis. This is the debt, regardless of assets in the shape of supplies, estimated to be worth $50,000, but hardly to be reckoned an offset to a company not in liquidation. It is claimed that the property is in better condition to-day than it was a year ago, and the report of President Bennett to the directors after an inspection of the Cleveland and Northwestern divisions appears to sustain the claim. He found 1,046 subscribers at the Minneapolis exchange, an increase of 296 in two years. A mile and one-half of new line was needed and ordered. He ordered 2½ miles of new line at Cleveland to meet growing wants. Three miles more were wanted at St. Paul by the 700 subscribers. The superintendent's report from the Southwestern division is also encouraging, and Erie people are altogether pleased with the situation. Stated reports are likely to be soon made by the directors.

More Telephonic Legislation.—A dispatch of July 25 from Cleveland, O., says: The telephone war, which the American Bell Telephone Company wages upon every company which uses instruments not furnished by it, has been begun in this city against the Citizens' Telegraph and Telephone Company. A suit for an injunction against the Citizens' Company has been entered in the United States Circuit Court by the American Bell Company and the Cleveland Telephone Company, which operates the Bell instruments. The Citizens' Company, which operates the Molecular instruments, was recently organized in this city with the following gentlemen as directors: George W. Short, H. P. McIntosh, David Morison, E. D. Sawyer, William Edwards, Thomas Axworthy, George A. Garrettson, Willis B. Hale, and George Hoyt. The company has been quite active in erecting poles, stringing wires, and placing Molecular instruments in business places and residences. A short time ago the Clay Telephone Company was bought out by the Citizens' Company, and the Clay instruments then in use were exchanged for the Molecular. The American Bell and the Cleveland Company claim that the Citizens' Company has been infringing upon the Bell patents, and suit was entered for the purpose of having the courts determine the matter and stop the Citizens' Company from further operations.

THE ELECTRIC LIGHT.

The Electric Light, etc., in Russia.—The Municipal Administration of Moscow is at present engaged upon the question of establishing an installation in the city, with the object of lighting and transmitting power therein.

Is it Electric?—A life-buoy signal has been invented, says the Chicago *Herald*, the purpose of which is to light up the sea in case of accident at night. It is attached to the life buoy by a cord, and upon being thrown overboard bursts immediately on striking the water. The light, which cannot be extinguished either by wind or wave, burns for over an hour, and thus enables the work of rescue to be easily carried on.

Electrically Illuminated War Balloons.—A series of experiments to show the practicability of flashing war signals at night by means of an electrically illuminated balloon, the invention of Eric S. Bruce, Esq., M. A., Oxon., will commence next Monday evening at the Albert Palace, under the personal superintendence of the inventor, who, after giving a short lecture, accompanied by interesting explanatory experiments in the concert room of the building, will, by the aid of a captive balloon of some four thousand feet capacity, show the utility of his invention in the grounds. The balloon will ascend to an altitude of five hundred feet, and on a clear night should be visible fifteen or twenty miles away. Mr. Bruce's invention has excited much interest among the military authorities, many of whom will be present at the initial ascent.

Theatrical Illumination.—Mr. James Shepherd, famed in Italy for his application of gas and electric lighting to theatrical scenic effects, is assisting Messrs. Borrachi and Corti, lessees of La Scala Theatre, in Milan, in their production of "Excelsior," a spectacular ballet illustrating the most striking mechanical discoveries and engineering achievements since the period of the Spanish Inquisition. Among the inventions and structural works which are considered sufficiently important for representation are the railway and locomotive, the steamship, the Suez canal, the Mont Cenis tunnel and Volta's electric pile. Mr. Shepherd was the means of introducing the Edison system of electric lighting into Italy, at La Scala Theatre, and subsequently illuminating the stage of the Teatro dal Verme, in the same city, by means of electric accumulators. For a ballet performance at Milan he once employed 14 six-thousand candle-power arc lamps and 16 two-thousand candle-power arc lamps. In the installation at Her Majesty's Theatre the Maxim-Weston generators and arc lamps are used, the motive power being an 8 horse-power Clayton and Shuttleworth portable engine. A unique and brilliant effect—said to be impossible by any other system of illumination—is produced by a portable arc lamp carried in the hand of one of the performers.

MISCELLANEOUS NOTES.

Fatalities from Lightning Strokes.—During the past fifty years it is said that 2,500 persons have been annually struck by lightning in France, the fatalities amounting to four per cent. as a yearly average.

Impure Iron by Electrolysis.—Professor Jacobi, of St. Petersburg, has ascertained that the iron obtained by electrolysis is not, as has been often thought, the pure metal, but, on the contrary, a compound or mixture of hydrogen, which, when heated to redness, gives off an enormous amount of that gas, and becomes, while greatly increasing in bulk, a silver white, very soft, ductile and malleable metal, which decomposes water below its boiling point, and oxidizes most rapidly.

An Interesting Experiment.—An account is given of an experiment made by Dr. Lecker to prove whether Faraday's famous experiment of rotating the plane of polarization by an electric current could be inverted. He has attempted to generate currents by rotating the plane of polarization of light, the arrangement being as follows: A ray of plane-polarized light was sent through the interior of two powerful helices of wire situated at some distance from one another. Through the first of these a powerful alternate current was sent, which impressed upon the ray a rapid oscillation of its plane of polarization; the second helix was connected with a sensitive receiving telephone, in the hope that sounds might therein be heard, as would be the case if the rapid rotations in the plane of polarization of the ray were capable of setting up currents in the surrounding wire. The result, however, of this interesting experiment was that absolutely nothing could be heard.

APPLICATIONS OF POWER.

The Distribution of Electrical Energy.—Messrs. Paris and Scott, of Norwich, have now in practical operation a system of electrical distribution. Their converter has an armature wound for high tension and low tension, and has, of course, two commutators. The high tension current drives the armature, the low tension side giving off the lighting current. By this means they are lighting some flour mills, where 45—50 volt. 20 C. P. lamps are fitted, the conductor between dynamo and converter being of No. 14 B. W. G. phosphor bronze wire; the distance the wire runs is about a mile. An eminent electrician is, we understand, about making measurements and tests as to the efficiency of the system. It is evident, however, that the loss in transformation must be much higher than that occasioned in the method adopted by Gaulard and Gibbs, and, in addition to this, the scheme has been before proposed if not actually carried out to a practical issue.—*London Electric Review.*

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on New York Stock Exchange, Boston Exchange and elsewhere are as follows:

Telegraph.—Am. Cable, b 61, a 62; B. & M., b 1¼, a 2; Western Union, b 65½, a 65⅝.

Telephone.—Am. Bell, b 200, a 202; Erie, b 25¼, a 25½; New England, b 34½, a 34⅝; Mexican, a 1 1/32; Tropical, b 1.

Electric Light.—No new quotations.

BUSINESS NOTICES.

Anti-Magnetic Shields for Watches.—These shields, made by Giles, Brother & Co., State and Washington streets, Chicago, are an efficient protection to the works of watches from magnetism, as many testimonials in their possession show. This firm also demagnetize watches that are already affected.

One of the greatest aids to rapid work at the desk is to be found in a good pen. Some fountain pens are of such a character, however, that they disguise the handwriting and thus detract from the value which they would otherwise possess. We have for some time been using the "Independent" fountain pen, made by Messrs. J. Ullrich & Co., of 106 and 108 Liberty street, this city, and have found it to work with uniform efficiency. It resembles an ordinary pen to all outward appearance, as the ordinary gold nib is retained and the ink is fed to its under side. For fast and easy work it is an excellent thing.

The catalogue of Messrs. Mitchell, Vance & Co., of this city, which has just come to hand, shows a large variety of the most beautiful electric light fixtures, electroliers, brackets, etc. Glancing through the pages we encounter elegant and artistic examples of workmanship, some of the designs being unique in their way. The incandescent lamp is well adapted for bringing out surprising effects, and the manufacturers have not neglected this property. Their book contains fixtures adapted to every situation, from the large ball-room electrolier to the single bracket and hall light. The catalogue is gotten up in true keeping with its contents, being most artistic in appearance, and showing great care in preparation.

Hill's Hair and Whisker Dye
Colors to any natural shade of black or brown; 50c.
PIKE'S TOOTHACHE DROPS will cure in one minute; 25c.
DEAN'S RHEUMATIC PILLS are a prompt, sure cure; 50c.
HALE'S HONEY, the great cough cure; 25c., 50c. and $1.
GLENN'S SULPHUR SOAP heals and beautifies the skin; 25c.
GERMAN CORN REMOVER kills corns and bunions; 25c.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED JULY 21, 1885.

1. Synchronous Telegraphy, 322,427; 2. Receiving Apparatus for Synchronous Telegraphs, 322,688; 3. Printing Device for Synchronous Telegraphy, 322,689; 4 and 5. Effecting Electrical Synchronous Movements, 322,690, 322,691; 6. Electrically Maintaining Synchronous Movements, 322,692; 7. Regulating the Vibrations of Forks, Reeds, etc., 322,694; 8. Mechanically Correcting the Vibrations of Reeds and Forks, 322,695; 9. Actuating and Correcting the Vibrations of Reeds, 322,696; 10. Relay for Synchronous Multiplex Telegraphy, 322,808; 11. Actuating and Correcting the Vibrations of Reeds and Forks, 322,809; Patrick B. Delany, Assignor to the Standard Multiplex Telegraph Co., New York, N. Y.; 12. Printing Telegraph for Synchronous Telegraphy, 322,693; Patrick B. Delany, New York, and E. A. Calahan, Brooklyn, Assignors to the Standard Multiplex Telegraph Co., New York, N. Y.

All these inventions are improvements and modifications upon former patents. Specifically they may each be described as follows:

1. Consists of a main line, synchronously-actuated apparatus at each end of the main line, a series of independent contacts with which the main line is successively momentarily connected by the rotation of the synchronous apparatus at each station, telegraphic transmitting apparatus at one station connected with one or more of said contacts, a condenser in circuit with said transmitting instruments and polarized receiving relay at the other station connected with the one or more corresponding contacts at that station, and a condenser in circuit with said receiving relay.

2. Consists of a main line, a relay therin, its contact-stops, two independent electro-magnets, an electric circuit which is completed through the coils of one of said magnets when the relay armature is on one of its contacts, a circuit which is completed through the coils of the other magnet when the relay-armature is on its opposite contact, an armature actuated by said independent magnets, the local circuit controlled by said armature, and the telegraphic sounder in said local circuit.

3. Consists of a main line, a table of independent contacts at each end of the main line, synchronously-actuated circuit-completing fingers which traverse said contacts, a main battery, a receiving-instrument connected with one or more contacts at one end of the main line, said receiving instrument consisting of the combination of signaling or printing devices, mechanism, circuits, and connections by which it is advanced or rotated step by step by periodic impulses of electricity received over the main line, and a lazy device or tardy circuit-completer which prevents the actuation of the printing or signaling devices as long as said impulses are regularly received, but permits the printing or signaling of a character when one or more of said impulses are prevented from passing over the line, and a transmitting device connected with the corresponding contacts at the other end of the main line, said transmitting device consisting of the combination of mechanism, as described, for sending periodic impulses into the line, transmitting devices for preventing one or more of said impulses from entering the line when a given character or signal is to be indicated or printed, and mechanism, circuits, and connections, whereby the printing or signaling devices of the transmitting-instrument are actuated step by step and maintained in the same relation to the printing or signaling devices at the receiving-station.

4. Consists of a main line, synchronously-actuated apparatus at each end of the main line, mechanism at one station by which the speed of the apparatus at that station is corrected when a correcting impulse of electricity is received from the distant station, and mechanism at the distant station for correcting the speed of the apparatus at that station when the correcting impulse of electricity is transmitted to the other station.

5. Embraces the method of synchronizing apparatus, which consists in sending a correcting impulse of electricity from one station to a distant station whenever the apparatus runs out of synchronism, utilizing said impulse at the distant station to correct the speed of the apparatus at that station, and simultaneously utilizing the same impulse to correct the speed of the apparatus at the station from which the impulse is sent out.

6. Consists of a main line, synchronously-actuated apparatus connected with each end of the main line, correcting devices at one end of the main line for accelerating or retarding the apparatus by varying the resistance of its controlling-circuit, a correcting-battery from which impulses of electricity are sent to operate said correcting devices, and contacts or devices at the apparatus at the end of the main line for completing the circuit from the correcting-battery to said correcting devices whenever the apparatus at the station to be corrected runs too fast or too slow.

7. Consists of the transmitting keys, their local circuits or branches of a circuit, the distributer or sunflower device, the actuating-magnet and actuating devices, the print-magnet and printing devices, a lazy device through which the circuit of the print-magnet is completed, and electric circuits and connections.

8. Consists of a continuously-automatically-actuated vibrator, means for continuously actuating it, and a device for mechanically correcting or controlling its rate of vibration.

9. Consists of the combination of the vibrator, the vibrator magnet, the independent correcting-magnet, its circuit and battery, the current from which normally does not flow through the coils of the correcting-magnet, and devices, substantially such as described, whereby the local battery of the correcting-magnet is caused to flow through its coils to correct the vibrator upon the passage of a correcting impulse over the line, as shown in the cut.

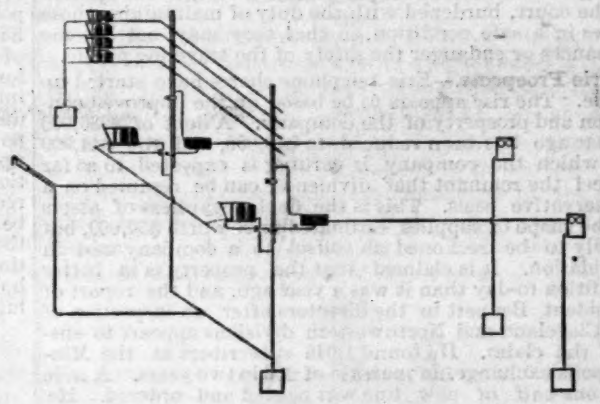
10. Consists of a relay having a permanent magnet arranged with its poles adjacent to the poles of the relay, the adjacent poles being of like polarity when the current is traversing the circuit, substantially as and for the purpose set forth.

11. Consists of a continuously automatically-acting circuit-interrupting vibrator, the vibrator-magnet, its fixed core and the adjustable pole-piece of the magnet, which may be adjusted toward or from the vibrator in a line coincident with the axis of the magnet, whereby the normal rate of the vibrator may be regulated.

12. Consists of the combination, with a vibrator, of some adhesive material applied thereto to regulate its normal rate of vibration.

Electric Signal Apparatus; Myron W. Parrish, Detroit, and Marcus F. Parrish, Niles, Assignors of one-third to Horace P. Peck, Allegan, Mich..... 322,474

Consists of the combination, with a train of cars, of a high-resistance circuit located in the engine, a lower-resistance circuit running through the train, a generator



322,835. SIGNAL-CALL FOR TELEPHONE OFFICES.

or battery in the circuits, an alarm or signal in the higher-resistance circuit, and one or more signaling circuit-breakers in the lower-resistance circuit in the cars.

Multiple Incandescent Lamp; William Stanley, Jr., Pittsburgh, Pa..... 322,496

Consists of the combination, with a group of incandescent electric lamps, of an electric conductor normally connected through one of said lamps, normally-interrupted branch circuits in which the remaining lamps of said group are respectively included, a shunt-circuit around each of said lamps, and an electro-magnet included in each of said shunt-circuits, and a circuit-closing device, under the control of each of said electro-magnets, which serves to complete the connections of said main-line conductor through a succeeding lamp in said group when a preceding lamp becomes inoperative.

Incandescent Electric Lamp; Philip K. Stern, Toronto, Ontario, Canada..... 322,498

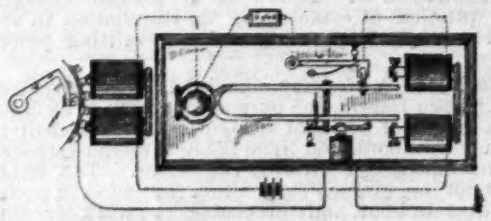
The filament is imbedded solidly and in contact in a mass of glass, which is inclosed in an air-tight glass bulb.

Apparatus for Suspending Arc Lamps; John Young, Chicago, Ill., Assignor to the Western Electric Co., same place..... 322,515

Consists of drums, pawl and ratch, and metallic caps through which pass the conductors.

Electric Railway; Edward H. Bently, Brooklyn, N. Y..... 322,517

Consists of the combination of sectional conductors extending along an electric railway, two opposite conductors



322,695. APPARATUS FOR MECHANICALLY CORRECTING THE VIBRATIONS OF REEDS AND FORKS.

in succeeding sections, electric locomotives in circuit between opposite sections and in series with one another, and an electric switch at the end of each section for breaking connection between two successive sections.

Underground Conduit; Daniel H. Dorsett, Chicago, Ill..... 322,529

There is a claim on the man-hole for such conduits, as follows: An asphaltum concrete man-hole for underground conduits for electrical wires, formed with a circumferential groove in its upper edge, and provided with a cross-bar secured in L-shaped recesses therein, in combination with a cover having a circumferential flange, and a locking-bolt passing through its centre into the cross-bar, substantially as and for the purpose set forth.

Electric Thermostat; C. Edmund Kells, Jr., New Orleans, La..... 322,612

A diaphragm and longitudinal spring are opposite each other, the former being convex toward the latter. A high heat expanding the diaphragm causes it to complete a circuit by coming in contact with the said spring.

Indicator for Electric Circuits; William A. Seipner and Charles Brotherhood, Clifton, England..... 322,619

Embraces circuit-closer (push-button type) with an electro-magnetic attachment to indicate to the eye or touch that a rheotomic bell at some distant part of circuit is ringing, the makes and breaks of the rheotome energizing and de-energizing the electro-magnet and operating the indicator.

Electric Door Opener; Thomas A Casey, New York, N. Y., Assignor to J. H. Bunnell & Co., same place..... 322,681

Consists of a revolving latch plate of a pinion geared thereto, and a locking device normally holding said latch plate in position, and an armature and electro-magnet for actuating said locking device.

1. Apparatus for Suppressing Induction Disturbances, 322,724; 2. Neutralizing Coil, 322,725; 3. Means for Suppressing Induction, 322,726; 4. Induction Neutralizing Coil, 322,727; 5. Process of Neutralizing Induction, 322,728; William A. Jackson and Josephus C. Chambers, Detroit, Mich., Assignors to George H. Lothrop, trustee, same place.

1. Plates of metal are inserted between the layers of coils.

2. The induction coil is compound, the two sets of coils being wound at an angle to each other.

3. The above combination is inclosed entirely within a helix, the latter windings being at an angle with those of the former.

4. Composed of a core having projecting pole-pieces, one or more electrical conductors partly or wholly inclosing said core, except said pole-pieces, a primary coil wound over said core and conductor or conductors, but insulated therefrom, and a secondry coil wound over the primary coil and in contact with said pole-pieces, each element being insulated from every other element.

5. Consists in a process of establishing an equilibrium between the disturbing currents and electrical charges of opposite polarity inductively generated by said disturbing currents.

Quadruplex Telegraph; Leon O. McPherson, Jefferson Township, Cook Co., Illinois..... 322,739

There are provided with a main line, two sources of electricity, two transmitting keys, one serving to vary the strength of a current transmitted to line, and the other to reverse its polarity, two receiving-instruments, the one responding to variations in strength and the other to changes in polarity of the main-line currents, a conductor leading from one pole of the source of electricity at any time having its other pole connected with the line, which conductor leads through said instruments to the earth, a second conductor leading from the first conductor through said instruments in the opposite direction to the main line, and an artificial resistance included in the last-named conductor.

Electric Switch; Edmund B. Nicolaus, Cleveland, O..... 322,745

Consists of a switch lever pivoted to one terminal and constructed and arranged to make a sliding frictional contact with the other terminal, and a retractile spring secured at one end to the switch lever, and at its opposite end to a fixed support, and arranged to have a tendency at all times to disrupt the contact and throw the switch lever to its open position, substantially as set forth.

Electric Indicating Apparatus; Milton W. Grovesteen, New York, N. Y..... 322,818

It operates with a device moving in either of two directions under the influence of variations in pressure, temperature, or quantity, etc., and consists of a shaft revolved thereby in a corresponding direction, a circuit-controlling device operated by the movement of said shaft in one direction to transmit electric impulses in a given direction, and an independent circuit-controlling device operated by the movement of said shaft in the opposite direction to transmit impulses in the direction opposite to that first named.

Signal Call for Telephone Offices; Albert H. Low, Denver, Colo..... 322,835

Consists of generators adapted to produce alternating and non-alternating electric currents located at the subscribers' stations, indicators located in the central office, and signal bells at the subscribers' stations, and automatic circuit-controllers and circuits, substantially as described, whereby the indicators or signal-bells are operated according to the character of the current transmitted and at the will of the operator. The connections are shown in the cut.

Electric Switch; Frederic Shaefer, Boston, Mass., Assignor by direct and mesne assignment to Leopold Schlegelmilch, trustee, same place.... 322,857

Consists of an inclosing-case, an insulating-block therein, and contact-pieces supported on the said block, each provided with a yielding upright, combined with the actuating-spindle pivoted between the contact-pieces and provided with a connecting-piece one arm of which engages one of the yielding uprights, and the other arm provided with a curved portion forces the second yielding upright from its normal position when the spindle is turned to break the circuit, the said yielding upright holding the connecting-piece in a given position in open circuit until the said spindle is positively moved to close the circuit.

Electric Railway; Ernest W. Siemens, Berlin, Germany..... 322,859

Consists of a suspended rail, a contact-truck having brushes that press against the under surface of a conducting rail, and a pendent socket having a flexible conductor leading to the railway carriage.

Telephone Receiver; J. Ensign Fuller, Chicago, Ill..... 322,884

Around a central telephone are concentrically arranged pole-pieces to the core of said telephone for the purpose of being under the influence of induction. A diaphragm lies on top of all the pole-pieces.